GIANT PINE OF CALIFORNIA. *Sequoia gigantea.*

A REPORT

ON THE

TREES AND SHRUBS

GROWING NATURALLY IN

THE FORESTS OF MASSACHUSETTS.

ORIGINALLY PUBLISHED AGREEABLY TO AN ORDER OF THE LEGISLATURE BY THE COMMISSIONERS ON THE ZOOLOGICAL AND BOTANICAL SURVEY OF THE STATE.

By GEORGE B. EMERSON.

VOL. I.

CONTAINING THE PINES, OAKS, BEECH, CHESTNUT, HAZELS, HORNBEAMS, WALNUTS, HICKORIES, BIRCHES, ALDERS, PLANE TREES, POPLARS, WILLOWS.

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To His Excellency Gov. Briggs:

Dear Sir, — The accompanying Report concludes the work of the Commissioners on the Zoölogical and Botanical Survey of the State. It has been prepared with especial reference to the instructions of Gov. Everett, accompanying his commission, and directing the Commissioners "to keep carefully in view the economical relations of every subject of their inquiry." I trust it may do something "to promote the agricultural benefit of the Commonwealth," by leading citizens who are land-owners to a consideration of the importance of continuing, improving, and enlarging the forests of the State.

It is due to the Legislature, and to yourself, that I should make some apology for the tardy appearance of my Report. It is well known to your Excellency, that ever since the commission was issued, in 1837, I have been occupied, for ten months of every year, in a pursuit which left me no leisure for the Survey, and little for reading on subjects connected with it. I have, therefore, been able to give to it only the summer vacation, and of that a considerable portion has, every year, been necessarily taken up with other things. Under these circumstances, it was hardly possible for me to give to the Survey the attention it deserved, and let my Report appear at an earlier period.

I am, respectfully,

Your Excellency's friend and servant,

GEO. B. EMERSON.

September 19, 1846.

PREFACE.

In order that this Report should answer the ends for which the Survey was ordered, the descriptions of the Trees and Shrubs are arranged according to the Natural System. This has been done, not from undervaluing the artificial system of Linnæus, which must continue of use in aiding to find the name of a plant and its place in the Natural System, but from a conviction of the incomparably greater value of the latter. The artificial system is based essentially on distinctions drawn from the stamens and pistils alone. The Natural System, on the contrary, takes into consideration not one part only, but every part and whatever relates to it, — the seed, from the development of its embryo to its germination; the growth, formation, and arrangement of the wood, bark, buds, and leaves; and the flower and fruit. It is found that plants which resemble each other in the external forms of their more essential parts have a similar resemblance in properties and uses, and require similar modes of management and culture. The adoption of the Natural System is, therefore, particularly important in a comparatively new country like ours. Upon the culture, properties, and uses of many of our trees and shrubs, few or no experiments have been made. We must learn what modes of culture are likely to answer

best with them, by observing what modes have been successful with well-known plants of the same families and affinities in the old countries. Of many of them, the value in building, and the various mechanic arts, in dyeing and tanning, and as furnishing articles of food, or materials for medicine, are not yet known. We shall be likely to find them most readily by looking for uses similar to what are known to belong to plants most analogous to them. "If there is," says De Candolle, "a country where the theory of analogy between forms and properties may become eminently useful, it is North America, which, situated in the same latitude as Europe, is occupied by analogous vegetation."

The uses of the natural arrangement in abridging the labor of acquisition, and aiding the memory of the learner, are most important; and its advantages to cultivators, to physicians, — to all who are seeking to enlarge their knowledge of the useful or dangerous properties of plants, that they may be able to avail themselves of the one, or counteract the other, to gain materials for the arts, or remedies or antidotes in medicine, — are too many to enumerate, and too obvious to be further insisted upon.

In the Conspectus, or Distribution into Families and Genera, I have attempted to offer a substitute, so far as the plants treated of in this Report are concerned, for the arrangement by the artificial system. This attempt I submit with many misgivings. If it shall be considered a failure, it may at least serve to aid others in more successfully accomplishing the object.

My sketches of the natural families, and, in a considerable degree, of the genera, are necessarily drawn mostly from books; and, as they are taken from the standard works of the science, — Endlicher, Lindley, Torrey, and

others, — are usually given without particular acknowledgment of the source. Botanists will here, however, find some points touched upon which have not usually received much attention from scientific writers.

The descriptions of the species of all the trees, and of nearly all the shrubs, are my own, except where I have expressly given credit to others. To collect my materials, I have scoured the forests in almost every part of the State, from the western hills of Berkshire to Martha's Vineyard, and from the banks of the Merrimac to the shores of Buzzard's and Narragansett Bays. The leisure of several summers was first spent in ascertaining what the ligneous plants of Massachusetts are, and how they are distributed. If I have not discovered new species, I have found new localities for several oaks, willows, poplars, pines, and birches, and some others of less importance; and have thus enlarged the Flora of the State. That some species have escaped me is altogether probable, as, even in the summer of 1845, I found the Red Birch growing abundantly on a branch of the Merrimac, some hundreds of miles further north than it had previously been noticed by any botanist.

After having become familiar with the trees and their localities, I began to collect materials for their description; and every important tree and shrub has been described from copious notes taken under or near the growing plant itself. A point with which I have each year been more and more struck, is the beauty of our native trees and of the climbing vines and undergrowth associated with them. I have thrown aside much which I had written upon this point. Utilitarian readers will perhaps find too much still retained. My apology for not pruning more severely must be found in my sincere conviction, that associations with the beauty of trees about our coun-

try homes enter deeply into the best elements of our character; and a hope that what I have written may induce some of my readers to plant trees, for the purpose of increasing the beauty and the appearance of seclusion and quiet of the homes of their wives and children.

In the progress of the work, I found it necessary to curtail very considerably what I had prepared, especially in regard to the families and genera, as it was evident, if I should go on to describe all the families with the same minuteness of detail even as is given to the pines and oaks, I should write several volumes instead of one.

In writing my descriptions, I have, as far as possible, avoided the use of technical language. To avoid it entirely is impossible. When a part, an organ, a form, or a modification of form is spoken of which has no English name, it must either be called by its scientific name, or be described by a tedious circumlocution, repeated as often as the thing is spoken of, and, after all, scarcely more intelligible even to the unlearned reader than the scientific word, which expresses precisely the thing meant and nothing else.

In the preparation of the Report, I have availed myself of whatever I found most to my purpose, but never, intentionally, without giving credit. The numerous facts obtained from Loudon and Michaux, are usually given in their words. Some of the best things are quoted from the incomparable descriptions of Dr. Jacob Bigelow. I am under obligations to Dr. Gray for suggestions in regard to the distribution into families and genera; but I should be sorry to have him considered responsible for any thing in its execution. Mr. Oakes has furnished me with many beautiful specimens, such as nobody else can make. To Mr. Russell, I am indebted for a communication upon the Pitch Pine, and for other favors. To my

friends, Messrs. E. Tuckerman and B. D. Greene, I owe thanks for the use of specimens from their extensive herbaria. Dr. Barratt, of Middletown, Conn., has given me important assistance in the study of the Poplars and Willows; and from the invaluable Report of my friend Dr. Harris, I have, with his consent, obtained much information, not to be found elsewhere, in regard to insects.

To so many citizens of the Commonwealth am I indebted for aid received in conducting the Survey and ascertaining the condition of the forests, that I can do no more than mention their names. From Hon. D. P. King and Messrs. S. P. Fowler, of Danvers; Josiah Newhall, of Lynnfield, and Lilley Eaton, of South Reading; J. L. Lewis, of Hingham, Samuel A. Turner, of South Scituate, and my friend G. P. Bradford, then of Plymouth; from Messrs. Chester Adams, of South Natick, and Daniel Adams, 3d, of Newbury; Daniel Davis, of Fairhaven, Thomas A. Greene, of New Bedford, and Hezekiah Barnard, of Nantucket; S. Davis, of Truro, Solomon Freeman, of Brewster, and E. Swift, of Falmouth; from Messrs. Jabez Newel, and Abijah M. Ide, of South Attleborough; Rhodolphus Sanderson, of East Whately, and D. Willard, of Greenfield; C. B. Rising, of Worthington, and Joseph Field, of Charlemont; C. S. Darling, of Gill, and Samuel Mixter, of New Braintree; Allen C. Metcalf, of Lenox, J. H. Cobb, of Dedham, and S. Salisbury, of Worcester; from Henry Colman, of the Agricultural Survey, and especially from William Bacon, of Richmond, Austin Bacon, of Natick, and Henry W. Cushman, of Bernardston, I received very useful letters, — from the three latter gentlemen, communications of great value.

To my friends, Dr. O. W. Holmes, whose poetical eye is also an eye for trees, and J. J. Dixwell, who knows

how to represent them, I am indebted for numerous measurements of trees; and to my learned friend Dr. A. A. Gould, who, to his other attainments in natural science, unites a familiar knowledge of botany, I am particularly indebted for most important advice and assistance in very many instances.

In the ship-yards in Boston, New Bedford, and other towns in the State, and the numerous saw-mills, machine-shops, and manufactories of furniture, of agricultural implements, and of all other articles of wood, and on the farms and wood-lots in all parts of the Commonwealth, whither I went, in almost all instances a stranger, to make inquiries, — everywhere, with one solitary exception, I was very civilly received, and had my questions answered with the greatest kindness and intelligence; and everywhere I found a readiness to furnish me, or let me furnish myself, with specimens of the flowers, leaves, fruit, and wood of the trees I was examining. To all persons from whom I have received these acts of kindness, I would here make my cordial acknowledgments. I shall always esteem it one of the best fruits of my labors in this Survey, that they have brought me better acquainted than I otherwise could have been, with the intelligence, hospitality, and good and kind manners of the common people in every part of the State. If there are better manners and a higher intelligence among the people in other countries, I should like to travel amongst them; but I very much doubt whether, in any country on which the sun shines, there are, amongst the people in common life, more of those qualities which are always pleasant to meet with, delightful to remember, and most honorable to our common humanity to record, than are found among the independent mechanics and yeomanry of Massachusetts.

Since the above was written, I have spent several years in Europe; and, in all the countries I visited, I have endeavored to become acquainted with the condition, intelligence, habits, feelings, and manners of the laboring classes; and what I have everywhere seen entirely confirms it all.

It was natural, for one inquiring as to what can and ought to be done for the preservation, restoration, and care of the forests, to endeavor to find out what has been done, and is doing, for them by the older nations; and, for this express purpose, I lately spent six months in Europe. I was allowed the freest access to all the gardens, parks, forests, and forest-schools on the Continent and in Britain, and every question I asked was promptly and satisfactorily answered. To give an account of all I saw and heard upon the management of the forests, would require a volume; and such a volume would not probably be much read, since a work upon this subject and others connected with it, of incomparably more value than any thing I could write, and richly deserving to be read by every person interested in the forests, remains unread. I refer, of course, to the volume called "Man and Nature," by George P. Marsh, at this moment our minister in Rome. It is a work of vast learning and research, containing the essence of all that has been written upon the subject, in all the languages of Europe, arranged in the clearest and most philosophical manner, and brought down to the comprehension of the common reader. Of this work, a new edition has recently (1874) been given under the title, "The Earth, as modified by Human Action," which is enriched by the results of the recent observation and inquiries of the author.

The care of the forests commands the serious attention of the government in nearly every country in Europe. The Department of the Forests, as we should call it, is everywhere a department of the highest importance. Even in the Roman States, where eighteen years ago there was not, to the knowledge of Professor Rolfe, professor in the Pope's garden at Rome, a single person paying attention to botany, there is now a class on that subject of more than a hundred students, many of whom listened with the greatest attention to the questions I asked, for more than an hour, amongst the trees, and to the ready and most satisfactory answers by the professor. And so it was in several other places.

In the vicinity of Florence, at Vallombrosa, on the top and sides of a lofty hill, there are a forest-school and garden, where more than forty young men are preparing themselves, by a course of two years' study, to know thoroughly all the trees, to manage every thing belonging to a forest, from the preparing the ground for seed beds, collecting and sowing the seeds of the trees, taking care of the young plants, to the transplanting them into the present or future forest, and the whole care and management of the forests.

In the northern part of Italy the forests have long received great attention, and they are now carefully studied everywhere. More books have been written upon them in Italian than in any other language in Europe, except only, for the last few years, the German.

Forests of Chestnut trees and of Olive trees cover the tops and sides of nearly all the hills from the neighborhood of Rome to the shores of the Italian lakes, and furnish a very important part of the food of the people. They are naturally, therefore, preserved and cared for. In cutting and in pruning them a degree of economy is

shown superior to any thing in this country, but common in all the countries of Europe. For fuel, no part is used except branches so small that, in this country, they would be left to decay, or to be burnt on the ground. All the larger pieces, with the trunk, are reserved for the carpenter, the builder, and other workers in wood. Yet, in all the large towns, even in Rome and Paris, wood is not so dear as it is in Boston.

In most parts of Italy, mulberry trees are planted over a large part of the fields under cultivation, and tall trees (usually Lombardy poplars), are left along all the boundaries and division lines in this country and in France. The consequence is, that the violence of the winds is so checked that all the operations of husbandry are pursued in comfort, and scarcely any tree is observed to lean in any particular direction; whilst, on the contrary, in New England, near the coast, nearly every tree has a very decided leaning towards the north-east.

In preparing for this second edition, I had thought of giving an account of the forests in Europe, and of the forest-schools. But this, properly done, would require so many pages as to increase my work to an unreasonable size. It ought to be done, and to be incorporated in a volume upon the Forests of the United States, showing their indispensable value, the rate at which they are disappearing, and the measures that might be taken, and must be taken, by the General Government and by the States, for their restoration and renewal. In hopes of doing something to induce the Government of the United States to take measures towards this end, I spent many days last winter at Washington, saw many of the leading men in both houses and in different departments of the Government, and urged the importance of action. I was received by all with the greatest

kindness, and all admitted the vast importance of the work that ought to be done. I laid a memorial upon the subject, from the Scientific Association, before the President, who highly commended the object, and sent our memorial to the Senate, to be referred to a certain committee, and as speedily as possible acted on. It was so referred; but, hitherto, nothing has been done.

In preparing illustrations for this edition of the "Trees and Shrubs of Massachusetts," I have endeavored to give the reader a more complete idea of the character of several of the most important Families, by exhibiting the trees as they are found in the forests of Europe, or under the best cultivation there. This may be a valuable aid to persons desirous of forming a collection of the characteristic species of Europe, and it will help to foresee the appearance of our own trees when cultivated in large numbers.

I have been cultivating, without special care, for more than twenty years, on land excessively poor and exposed to all the winds, a few rods from Boston Bay, all the varieties of the English Oak, Beech, Birch, Linden, Maple, Elm, Ash, Mountain Ash, and Pine, and find them more hardy than the corresponding American trees, with a single exception. Our Canoe Birch grows equally well with the beautiful European Birch (*Bétula álba*). Our hardiest oaks, the Red, the Black, and the Pin Oak, in the same situation, do not do so well as the English. Our White Maple, alone, does as well as the two best European, — the Sycamore (*Acer pseudo-platanus*) and the Norway (*Acer platanoìdes*). Our best maple — the Rock Maple — can with difficulty be made to live in the same situation. The English Pine, or Scotch Fir (*Pinus sylvestris*), does much better than our White Pine (*Pinus stròbus*), our Pitch Pine (*Pinus rígida*), or our Red

Pine (*Pinus resinòsa*), all of which have the reputation of being hardy trees. Whether European trees will thrive as well for the next twenty years, I have no means of knowing.

I have also given figures of several remarkable trees, such as the Cedar of Lebanon, the Cypress of Somma, the Giant Pine (*Sequoia gigantea*); because they are of historical interest or of wonderful size. I have, wherever it was possible, given the names of the artists to whom the engravings are due; for the success of this edition, if it do succeed, will be at least as much due to the artistic skill and exquisite taste of my friend Isaac Sprague, as to any thing that I have done. It would be unjust if I did not acknowledge my indebtedness to my excellent friend, Dr. Asa Gray, who has done more than any one else to correct my mistakes and to rectify my descriptions.

In the whole of my work I have done what I could to wake up the people of Massachusetts to the value of their forests, and to prevent, or to postpone, the fulfilment of the prediction of Bryant's Indian at the Burial-place of his Fathers: —

"But I behold a fearful sign,
To which the white men's eyes are blind.

Before these fields were shorn and tilled,
Full to the brim our rivers flowed;
The melody of waters filled
The fresh and boundless wood;
And torrents dashed and rivulets played,
And fountains spouted in the shade.

Those grateful sounds are heard no more:
The springs are silent in the sun;
The rivers, by the blackened shore,
With lessening current run;
The realm our tribes are crushed to get
May be a barren desert yet."

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CHAPTER II. *Amentaceous Plants.*

EXPLANATION OF THE PLATES.

[The origin of the plates is always given when known, and also the artists. All the colored plates, and those without a name, are by Isaac Sprague.]

TREES AND SHRUBS

OF

MASSACHUSETTS.

TREES AND SHRUBS

OF

MASSACHUSETTS.

THE FORESTS.

THE immense variety, the many and important uses, and the great beauty of our forests, must, naturally, attract the attention of an observer; and, as the preservation and improvement of the forests, in their highest degree, are above private effort, require joint action, and must be effected on a large scale, on a system wisely begun and long continued, by the men of one generation for those of the next; and by the application of science, taste, and skill, not by one but by many men, not in one village or town, but in a county and state; it is wise in a government not acting merely for the present, but extending its forethought generously onwards, making its knowledge and wisdom an invested capital for future use, and desiring to do for coming generations, what they, when looking back, shall wish it had done, — it is wise, prudent, and patriotic for such a government to order a survey of the forests, among its other domains, that the people may know the sources of their wealth and its extent, and learn how to value, enlarge, and enjoy it. The conception and ordering of this general survey was worthy of the descendants of those who established free schools, free courts of justice, and freedom in religion. The idea was a noble one, with whatever success the work may have been executed.[1]

[1] When we consider the immense advantages derived from the presence and the terrible evils necessarily resulting from the destruction of the forest, both the preservation of existing woods, and the far more costly extension of them, where

The object of the present report is to describe the trees and shrubs of the forests of Massachusetts; to set forth their importance, their general and particular relations, uses, and properties, and the modes by which they may be preserved, propagated, and improved. It is not written for the use of men of science. If any such read it, however, they may find in it many particulars relating to trees which have not been hitherto recorded; as they may miss much which a more scientific inquiry would have brought to light. But it is for the common, unlearned citizens, who live on farms, in the country, and have few books but abundance of leisure. It is, as far as possible, for it cannot be wholly, divested of technical language, in order that they may understand it. And it will accomplish the purpose for which it was written, if it awaken them to a deeper sense of the value of some of the blessings by which they are surrounded, and lead them, or any of them, to resolve to preserve the old forests and plant new.

A few generations ago, an almost unbroken forest covered the continent. The smoke from the Indian's wigwam rose only at distant intervals; and, to one looking from Wachusett or Mount Washington, the small patches laid open for the cultivation of maize interrupted not perceptibly the dark green of the woods. Now, those old woods are everywhere falling. The axe has made, and is making, wanton and terrible havoc. The cunning foresight of the Yankee seems to desert him when he takes the axe in hand. The new settler cleared in a year more acres than he could cultivate in ten, and destroyed at a single burning many a winter's fuel, which would better have been kept in reserve for his grandchildren. This profuse waste is checked, but it has not entirely ceased. It is, however, giving way to better views. Even since this survey was begun, a wiser economy shows itself. May it be universal.

they have been unduly reduced, are among the most obvious of the duties which this age owes to those that are to come after it. Especially is this obligation incumbent upon Americans. — George P. Marsh, *Man and Nature*, p. 327.

A brief consideration of the general uses of forests on a great scale may have a tendency to produce this effect.[1]

USES OF THE FORESTS.

1. Forests create or gradually but constantly improve a soil. The roots penetrate deeply into the ground, and thus let in the air to produce its slow but sure effects. The radicles decompose the grains of sand, and extract from them some of the elements essential to a soil; they drink in moisture and the carbonic acid which has been formed beneath, or brought down from the atmosphere above, the surface, and, from these several elements, acted on by heat, light, and air, in the leaves, and by that unknown influence, vegetable life, are formed the various substances which compose the plant. The annual deposit of leaves, and the final decay of the branches and trunk, go to constitute the mould upon which other plants grow. And the soil thus formed is kept by the thick matting of the roots from washing away.

An unprotected hill soon loses its soil. Every rain bears away a portion, till it becomes a bare rock, and the slow process must recommence by which rock had been originally converted into or covered with soil. That process takes place slowly on all uncovered rocks, but far more surely and rapidly under cover of trees. There also the invisible sporule, borne thither on the wind, perhaps, from a distant continent, attaches itself to the naked rock and vegetates; encrusting its surface with a lichen which gets thence a foothold and an alkali, while it lives on the atmosphere. From the thin layer left by its decay, another species springs, which, in turn, gives place to mosses and herbaceous plants. Whoever has climbed Monument Mountain in Stockbridge has had an opportunity of

[1] At the time of this second edition, many persons, in every part of Massachusetts, have become aware of the value of the forests, and are every year giving more acres to the growth of trees.

observing this process in its different stages and circumstances On the projecting cliffs of white quartz, of which the mountain consists, the beautiful lichens which paint its sides have made no more progress than if the mountain had been thrown up two years ago. They are spread upon it as thin as paper, and perfectly fresh. Wherever they decay, the violence of the rain and winds washes them clean off, and the work is begun each year anew. But, in the protected crevices, and under shelter of the few trees and shrubs that have found root-hold there, a soil is forming or is already formed. What happens here takes place on all mountain tops in New England. A sheltering tree allows the creative action to take place.

2. Another use of forests is to serve as conductors of electricity between the clouds and its great reservoir the earth; thus giving activity to the vital powers of plants, and leading the clouds to discharge their contents upon the earth. A few tall trees, on the summit of a hill, are sufficient to produce this effect. A charged thunder cloud, which passes unbroken over a bare hill, will pour down its moisture, if its electricity is drawn off by these natural conductors. The dry sterility of some parts of Spain, anciently very fertile, is probably owing, in a great degree, to the improvident destruction of the forests, and the absurd laws which discourage their renewal. The forests also coat the earth and keep it warm in winter, shutting in the central heat which would otherwise more rapidly radiate into space and be lost. If you go into the woods at the end of a severe winter, you may anywhere easily drive down a stake without impediment from the frost; while, in the open field by their edge, you find a foot or more of earth frozen solid. Forests act not less favorably as a protection against the excessive heat of the summer's sun, which rapidly evaporates the moisture and parches up the surface where unprotected. The first mahogany cutters in Honduras found the cold under the immense forests so great, that they were obliged,

though within 16 degrees of the equator, to kindle fires to keep themselves warm.[1] The snow falling evenly in the still air of the forest, and preserved from being suddenly melted by the sun, with the rain falling on the woods even of a hill-side, is retained by the deep and spongy mass formed by the roots and the accumulated deposit of leaves and the soil beneath, instead of rushing down, as it otherwise would, in torrents, carrying with it great quantities of loose soil. Protected also from rapid evaporation, it remains laid up as in a reservoir, trickling gradually out and forming perennial streams, watering and fertilizing the low country through the longest summers, and moderating the violence of droughts by mists and dews. All along the coast of New England, numerous little streams, which were formerly fed by the forests, and often rolled a volume of water sufficient to turn a mill through the summer, are now dried up at that season, and only furnish a drain for the melting snows of spring, or the occasional great rains of autumn.

Forests thus equalize the temperature and soften the climate, protecting from the extremes of cold and heat, dryness and humidity.[2] There is little doubt that, if the ancient forests of Spain could be restored to its hills, its ancient fertility would return. Now there is nothing to conduct electricity, nothing to arrest the clouds and make them pour their treasures upon the earth, no reservoirs to lay up the winter's rain in store against the droughts of summer.

3. Forests protect a country from the violence of winds. The lively author of "Life in Mexico" writes,[3] "M. de Humboldt, who examined the will of Cortes, informs us that the

[1] "At Guiana, in South America, within 5° of the line, the inhabitants living amid immense forests, a century ago, were obliged to alleviate the severity of the cold by evening fires. Even the duration of the rainy reason has been shortened by the clearing of the country, and the warmth is so increased, that a fire now would be deemed an annoyance." — *Ure's Dictionary of Chemistry*, article, Cli nate.

[2] The snow falling evenly in the still air of the woods, and preserved from being suddenly melted by the sun, is left, as it gradually melts, as in a storehouse, to trickle gradually through the summer

[3] Volume II., p. 52.

conqueror had left sugar plantations near Cuyoacan, in the valley of Mexico, where now, owing, it is supposed, to the cutting down of the trees, the cold is too great for sugar-cane or any other tropical production to thrive." And a most intelligent gentleman in Worcester tells me, that he attributes the greater difficulty now experienced in the cultivation of the more delicate fruits in that town, to the fact that the encircling hills, formerly crowned with trees, are now, to a considerable degree, laid bare. The laws of the motion of the atmosphere are somewhat similar to those of water. A bare hill gives no protection. The wind pours over it as water pours over a dam. But if the hill be capped with trees, the windy cascade will be broken as into spray. Its violence will be sensibly diminished. We are not aware, on the now protected and irregular surface of New England, how important are the screens furnished by the forests. But, on the vast prairies in Illinois and some of the other western States, the wind is almost always fresh, and often blows a gale before which men can hardly stand. The new settlers were glad to shelter their habitations under the lee of the spurs of forest which stretch like promontories into the prairie lands, and extensive plantations of forest-trees have been recently formed for shelter, as well as for other uses. A forest near the coast, in any part of New England, protects those farther inland from the chilling east winds; and, while such winds prevail, a person passing towards the sea, experiences a marked change of temperature upon crossing the last wood, and especially the last wood-covered hill. One who would have his house screened from the northerly winds, must take care to have behind it a hill crowned with trees, or at least to have a wood stretching from the north-west to the north-east. A garden surrounded by tall trees admits the cultivation, even in our severe climate, of plants almost tropical.[1]

[1] "The sensible cold is never extreme in thick woods, where the motion of the air is little felt. The lumber men in the northern States and in Canada labor in the woods without inconvenience, when the mercury stands many degrees below

Forests not only protect from winds: they must prevent their formation. The air resting over a broken surface cannot be rapidly heated to a uniformly high temperature, so as to rise upwards in great masses and create a violent wind.[1]

the zero of Fahrenheit, while, in the open grounds, with only a moderate breeze, the same temperature is almost insupportable." — *Man and Nature*, p. 164.

"In countries in the temperate zone still chiefly covered with wood, the summers would be cooler, moister, shorter, the winter milder, dryer, longer, than in the same regions after the removal of the forests." — *Man and Nature*, p. 179.

I should have to quote many pages, if I should take from "Man and Nature" what is of the greatest interest upon this subject.

[1] A writer in the 6th volume of the "N. E. Farmer," says, "It is not merely in forests, nor as supplying firewood and timber, that trees are valuable. 'Considered agriculturally,' says an English writer, 'the advantages to be derived from subdividing extensive tracts of country by plantations are evidently great, whether considered in the light of affording immediate shelter to the lands, or in that of improving the local climate.' The fact that the climate may be thus improved has, in very many instances, been sufficiently established. It is indeed astonishing how much better cattle thrive in fields even but moderately sheltered, than they do in an open, exposed country. In the breeding of cattle, a sheltered farm, or a sheltered corner in a farm, is a thing much prized; and in instances where fields are taken by the season for the purpose of fattening cattle, those most sheltered never fail to bring the highest rents. . . . Dr. Deane has observed, 'Pasture lands should be well fenced in small lots, . . . and these lots should be bordered at least, with rows of trees. It is best that trees of some kind or other should be growing scattered in every point of a pasture, so that cattle may never have far to go, in a hot hour, to obtain a comfortable shade.'

"Small lots, thus sheltered, are not left bare of snow so early in the spring as larger ones lying bare; since fences and trees cause more of it to remain on the ground. The cold winds in March and April hurt the grass much when the ground is bare; and the winds in winter will not suffer snow to lie deep in land that is too open to the rake of winds and storms." — *N. E. Farmer*, VI., 350.

In Europe, forests are considered as protecting from hail storms. "When the chains of the Alps and the Apennines had not yet been stripped of their magnificent crown of woods, the May hail, which now desolates the fertile plains of Lombardy, was much less frequent; but, since the general prostration of the forests, these tempests are laying waste even the mountain soils, whose older inhabitants scarcely knew this plague." — Cairni, as quoted by Marsh, *Man and Nature*, p. 140.

Dr. Piper says and proves, that "Droughts and the drying up of rivers, lakes, &c., and freshets, also, are due to the destruction of our forests. The extreme and rapid changes of weather which, of late years, have been so frequent, and which exert so pernicious an effect upon vegetation, are probably due to the same cause. . . . In the woods, as every one is aware, the snow remains much longer than in the open country; and as, of course, it lies level there, the ground beneath is frozen only to a slight depth. When a thaw commences, the porous nature of the soil," made up, to a considerable depth, of leaves and small branches in every condition of decay, "retains the water until the earth is thawed;

4. As adding to the beauty of a country, the forests are of the utmost importance. A country destitute of them cannot

when it slowly trickles through its pores, to the small streams and ponds which supply the rivers, which, by this process, are kept in an equal state of flow" almost through the year. "But in the open country the surface of the ground is more regular, and the soil more compact, while in winter it is frozen to a much greater depth; and, as the snow is usually blown into heaps, the frost penetrates irregularly, so that, in the bare spots, a long time is required before it can be thawed. Under these circumstances, when the weather becomes warm, or rain falls, the water must at once concentrate in the ponds and small streams. These, in their turn, pour out their overflowing contents, and thus cause the terrible freshets which every year devastate portions of our country. In addition to this, the unobstructed blowing of a warm wind will dissolve the snow more than ten times as fast as when, at the same temperature, it is protected from the wind. To determine this point, during the winter of 1856–57 I tried, among others, the following experiments: —

"*First.* A body of snow, one foot in depth and sixteen feet square, was protected from the wind by a tight board fence, about five feet high, while another body of snow, much more sheltered from the sun than the first, six feet in depth and about sixteen feet square, was fully exposed to the wind. When the thaw came on, which lasted about a fortnight, the larger body of snow was entirely dissolved in less than a week, while the smaller body was not wholly gone at the end of the second week."

"*Experiment Second.* Equal quantities of snow were placed in vessels of the same kind and capacity, the temperature of the air being seventy degrees. In the one case a constant current of air was kept passing over the open vessel, while the other was protected by a cover. The snow in the first was dissolved in sixteen minutes, while the latter had a small unthawed portion remaining at the end of eighty-five minutes; that is, it melted five and one-third times as fast in the first case, where a feeble current of air was kept up, as in the other, where the snow was covered from the air."

"*Experiment Third.* . . . The temperature of a room being above eighty degrees, the mercury in a thermometer rose from thirty-two to eighty degrees in one seventh of the time, when an artificial current of air was kept up by means of a fan, as it did when the instrument, placed in the same position as in the first case, was allowed to remain undisturbed. As a further illustration of the rapidity with which thawing is produced by the unobstructed blowing of a warm wind, a gentleman informs us that he has found, by actual experiment, that ice will waste more in one or two hours, under this condition, than during a whole day of sunshine, when it is entirely sheltered from the wind. From this we may perceive how freshets may be produced by the action of the wind, and also the only means we have in our power to guard against their production." — R. U. PIPER, *Trees of America*, pp. 48 and 49. We may plant a forest. "And the Creator has placed it within the ability of every one to aid in this, as the humblest individual can plant a tree. The causes which produce freshets, as also the freshets themselves. The unobstructed blowing of the wind, especially if it be warm and dry, is, as is well known, the most rapid possible method of producing evaporation, and thus, perhaps, the main cause of drought." — Ibid.

"Within about one half of a mile of my residence (Woburn, Mass.), there is

be in the highest degree beautiful. If the green hills of Berkshire were stripped of their woods, they would be converted into broad reaches of upland, from which most of their beauty would have departed. The striking feature in that charming country is the old forest, on the sides of its hills, here and there irregularly broken in upon by cultivation. The northern and southern sides of Boston are not essentially unlike in their natural features; yet the hills of Brookline and Roxbury, capped with hickory and chestnut, and whose sides are clothed with oaks and pines, give the impression of a rich and happy country, of which only pleasant memories are carried away, while the bare hills of Chelsea suggest images of bleak and barren desolation.[1] Three or four trees upon Apple Island make it a gem among the islands in Boston Harbor. What a scene would the Bay present, if all the islands were so covered!

No element of beauty is so completely manageable as trees, and our resources in that respect are surprisingly great. Situated in the middle of the temperate zone, we have, in Massa-

a pond upon which mills have been standing for a long time, dating back, I believe, to the first settlement of the town. These have been kept in constant operation until within some twenty or thirty years, when the supply of water began to fail. The pond owes its existence to a stream which has its source in the hills, which stretch some miles to the south. Within the time mentioned, these hills, which were clothed with a dense forest, have been almost entirely stripped of trees; and, to the *wonder* and loss of the mill-owners, the water in the pond has failed, except in the season of freshets; and, what "was never heard of before," the stream itself has been entirely dry. Within the last ten years, a new growth of wood has sprung up on most of the land formerly occupied by the old forest; and now the water runs through the year, notwithstanding the great droughts of the last few years, going back from 1856." — R. U. Piper, *Trees of America*, p. 50.

"Forest trees should be preserved for their beneficial influence upon the climate. It is universally conceded that the winters in the northern States are colder than they were thirty or forty years ago, and that the weather is more windy, fluctuating, and disagreeable. We are also subject to severer droughts. Peaches once grew in abundance throughout Central New York," and in many parts of New England. "Now it is almost impossible to raise them. The wheat and some other crops are more uncertain. These facts are to be ascribed not so much to the deterioration of the soil, as to the destruction of our forests." — Ibid. p. 51.

[1] The appearance of these hills is much improved since the above was written.

chusetts, all the best of the deciduous trees, — the oaks, elms, beeches, ashes, hickories, walnuts, cherries, maples, the chestnut, linden, and button-wood of the temperate regions; together with the finest of the evergreens, — the pines, firs, spruces, cedars, and hemlock, and the delicate birches, of a more northern climate. Each one of these trees has its own peculiar and distinctly marked character, recognizable at a distance, and producing an effect which needs not to be mistaken for that of any other. Each has its own cycle of change, its own time of flowering, and of perfecting its fruit, and of opening, maturing, changing, and casting its foliage. Each has its own shape and its own color, distinguishing it from every other tree, even of the species most nearly allied. Hence the endless variety of our forest scenery. Here are more than fifty elements shading off and blending into each other in imperceptible gradations, according as you recede from the coast to the interior, as you go north or south, or as you rise from the plain into the mountains. We have here representatives of the vegetations of the warmer and of the colder regions; but, as you go north, first the hickories, then most of the other nut-bearing trees, then others, gradually leave you, and give place to hardier foresters. As you go south, the same gradual change takes place from the desertion of the pines and birches, and the addition of new oaks and other trees. Every one feels the difference in the effect produced on the mind by the forests of Berkshire and the woods of Norfolk or Essex county. The practised eye detects the cause of the difference in the different trees which constitute the forest, and still more in the different proportions in which the same trees are combined.

These numerous trees and the still more numerous flowering shrubs which belong to our forests, all capable of being made to flourish freely in every part of the State, give the planter who is studious of the effects of landscape inexhaustible resources. Some of the trees grow habitually to the height of only thirty or forty feet; others rise to seventy or a hundred.

Judiciously grouped in planting, they are capable of giving to a level plane the appearance of any desired inequality of surface. The tall pines, elms, and sycamores, at a distance, will seem to occupy a hill; the hickories and maples, to clothe its sides; while the spreading beeches, broad oaks, and hanging birches will form the gradual descent to the plain. Among these, a winding path, leading under or near the largest trees and behind thickets, may give to a few acres all the advantages of variety of a large forest.

To many persons, the pleasantest season in our climate is autumn, and, to a lover of nature, the rich and infinitely varied gorgeousness of the autumnal woods is a most important addition to the enjoyment of that season in the country. Each tree has its own color, or rather its own class of colors, — tints and shades which belong to it and to it alone. Trees to be planted about a residence should be selected in reference to this circumstance, as well as to the time and variety of their flowering. Early autumn becomes gay with the vivid crimson of the tupelo and the sumach. A little later come out the rich orange and yellow of the sugar-maple, with the gold and scarlet of the red flowering maple. The soft olive tints of the ash, the warm browns of the hickory, the purples of the cornus florida, the buffs and yellows of the birches, give place at last to the full scarlets, yellows, and browns of the oaks, many of whose leaves remain adhering through the snows of winter. These and forty other trees, and twice as many shrubs, furnish as inexhaustible a store-house of colors as they do of shape and foliage. It would be endless to speak of the adjuncts of trees, — the climbing shrubs; the Virginia creeper, so remarkable for the richness of its fading colors; the Roxbury wax-work, for its berries; the ivy, the vine, and the climbers, which naturally attach themselves to our trees, and which may be trained upon them in cultivation; the lichens, which cloud and paint their trunks with touches of green and yellow, white and brown; and the mosses, of brilliant green or purple velvet, which grow

about their base. All these are studies for the landscape gardener, and their daily observation will add immeasurably to the pleasure of the contemplative man who dwells in or traverses the country in autumn, with the eye of a painter and the feelings of a poet, or with those of a worshipper of the Author of these beauties.

It is surprising how small is the number of trees necessary to produce a striking effect. Ten or twelve trees, fortunately or skilfully disposed on the sides or brow of a hill, are often sufficient to give it an air of richness harmonizing perfectly with a highly cultivated country. The happy effect of three or four trees on an island in Boston harbor has been already mentioned; a single one on Pettick's Island gives an agreeable relief to the eye. A single elm or beech by a farmer's house protects it, and gives it a desirable air of seclusion and rest; as if it must be the residence of peace and contentment. One almost covets a house so pleasantly sheltered. While an unprotected, solitary house seems to shiver in the north wind, and we involuntarily wish for the inhabitants a more cheerful home. Why should not at least one tree be found growing near the dwelling of every man, even the poorest and humblest?

Nothing can better illustrate the variety of our forest trees, compared with the European, than a criticism of the learned Hallam upon a passage in Spenser's Fairy Queen. It is that in the first book where a shady grove is described, in which the knight and lady take refuge. The critic objects "to the stanza enumerating as many kinds of trees as the poet could call to mind, —

> 'The sayling Pine, the Cedar proud and tall,
> The Vine-propp Elme, the Poplar never dry,
> The builder Oake, sole king of forests all,
> The Aspine good for staves, the Cypress funerale,' —

with thirteen more in the next stanza. Every one knows that a natural forest never contains such a variety of species."

The other trees mentioned are the laurel, fir, willow, yew, birch, sallow, myrrh, beech, ash, olive, platane, holm, maple; in all twenty. Now the forest nearest to Boston which has been left undisturbed, and it is within four miles of the city, in Brookline, contains, in less than half a mile's space, the white-pine, the red-cedar, the elm, the large-leaved poplar, the white-oak, the aspen-leaved poplar (called aspen by our ancestors from its resemblance to the tree of that name in England) the willow (two or three species), the poplar-leaved birch (most near akin to the European), the ash, the beech, the plane, or button-wood, the red-flowering maple (to correspond with those of the same name), the hemlock, the tupelo, the spruce, the pitch-pine, the alder, the shellbark, the hornbeam, the lever-wood (to stand against the others named); and, moreover the red-oak, the black and the swamp oak, the sugar-maple, the yellow-birch, the black-birch, the square-nut hickory, the pig-nut, the bitter-nut, the chestnut, and the linden, all growing as they were planted by the hand of nature. If it be objected that it is unfair to enumerate several species of one genus, it may be answered that these are all quite as unlike each other as are the willow and sallow, or the poplar and aspen, of Spencer's catalogue. It is true that we do not often find in Massachusetts so great a variety in the same wood, except upon soil from the pudding-stone or conglomerate formation. The various ingredients of that rock seem to furnish the materials necessary for the ready growth of every kind of tree of our climate.

5. In a country so much exposed as ours is, in consequence of the remarkable clearness of the atmosphere, to the burning heat of the sun, the use of trees for shade is not one of the least important. This use is closely allied to the last. A tree which furnishes a cool shade to the inhabitants of a house, is at the same time and on that account its best ornament. At the season when men travel for pleasure, a plain, low, modest house, with an open grass plot before it, shaded by an oak, a

beech, or an elm, speaks more to the feelings and is more beautiful than the showiest house unprotected from the sun. The traveller in a hot day welcomes every tree on the road-side. Even a thin fringe of grey birches looks pleasant; and he remembers thankfully the kindness or good taste which has spared, or planted a tree with a head broad and thick enough for him to rest under and cool himself.

Trees should be planted not only by dwelling-houses and along roads; they should be in every pasture, and by watering places, and near every barn, — wherever cattle, horses, or sheep are to be provided for. All these animals suffer from our burning sun; and, to say nothing of their enjoyment, the cost of shade-trees will be many times paid back in the saving of the milk, fat, fleece, and strength, which will be the consequence of their being protected from the heat of the sun.

6. The influence of the forest upon the healthfulness of the atmosphere demands thoughtful consideration. "Plants imbibe from the air carbonic acid and other gaseous and volatile products, exhaled by animals, or developed by the natural phenomena of decomposition."[1] These, the tree, more than smaller plants, absorbs; and, instead of them, pours into the atmosphere pure oxygen, essential to the life of animals. The carbon, the very substance of wood, is taken from the carbonic acid thus absorbed. "Humid air," says Bequerel, "charged with miasmata, is deprived of them in passing through the forest." Rigaud de Lille observed localities in Italy where the interposition of a screen of trees preserved every thing beyond it, while the unprotected grounds were subject to fever. "The belief that trees afford an important protection against malarious influences is very general among Italians best qualified to judge upon the subject." "Maury believed that a few rows of sunflowers, planted between the Washington observatory and the marshy banks of the Potomac, had saved the

[1] SCHARTZ, *Les Arbres*, as quoted by Marsh.

inmates of that establishment from the intermittent fevers to which they had been formerly liable. Maury's experiments have been repeated in Italy." "In fact, the generally beneficial effects of a forest wall, or other vegetable screen, as a protection against noxious exhalations from marshes, or other sources of disease, situated to the windward of them, are very commonly admitted."

"It is well known that the great swamps of Virginia and the Carolinas are healthy, even to the white man, so long as the forests in and around them remain, but become insalubrious when the woods are felled." — Marsh, *The Earth as Modified by Human Action*, p. 56–8.[1]

7. The importance of the forests as furnishing materials for ship-building, house-building, and numerous other arts, is so obvious that it must occur to every one; and yet there is danger that, in many places, from false views of immediate economy, no provision will be made for the wants of future generations. It is not easy to estimate the pecuniary value of the wood used in house-building. A vast deal of this is continually going on; the aspect of the State is annually everywhere improving by the erection of larger, better finished, and more commodious houses, barns, and out-houses. And almost

[1] "In Australia and New Zealand, as well as generally in the southern hemisphere, the indigenous trees are all evergreens. In those regions, even in the most swampy localities, malarious diseases are nearly, if not altogether, unknown. Is this important fact due to the persistence of the foliage?

"Except in the seething marshes of southern tropical and subtropical regions, where vegetable decay is extremely rapid, the uniformity of temperature and of the atmospherical humidity renders all forests eminently healthful." — Hohenstein.

"The flat and marshy district of the Sologne, in France, was salubrious until its woods were felled. It then became pestilential; but, within the last few years, its healthfulness has been restored by forest plantations." — Clavé.

"There is no question that open squares and parks conduce to the salubrity of cities, and many observers are of opinion that the trees and other vegetables with which such grounds are planted contribute essentially to their beneficial influence." — Marsh, *ubi supra*.

"It has been observed in Sweden, that the spring, in many districts where the forest has been cleared off, now comes on a fortnight later than in the last century." — Abjornson.

all the materials have been, hitherto, except for the seaboard towns, furnished by our own woods. But no returns of these improvements are published. The thousands of tons of timber, boards, clapboards and shingles, are not put on record. It is manifest, however, that the difference against us would be great, if we had to look elsewhere for our materials. It is indeed very desirable that better taste and more just views of economy should introduce the fashion of building dwelling-houses, barns, and other large structures, of stone. They would then be built, as the forests must be planted, for future generations. The best building stones are abundant in almost every part of the State; so much so that, in many places, they are heaped together in walls much higher and wider than are necessary for the protection of the fields. If the buildings were formed of stone, they would be a permanent addition to the value of the property, while, on the contrary, the present transient structures are an inheritance to be perpetually repaired and renewed.

As to ship-building, we have some data. The returns[1] from the various towns in the State, made in 1837, show that the average annual value of ships built in five years before that time was $1,370,649. A great portion of the materials was, and a greater might have been, furnished by our forests, if the oaks and pines of our hills had not been most improvidently wasted by our ancestors.

The valuable document to which I have referred, shows that in 1837 the annual value of casks and hoops made in the State, of chairs and cabinet ware, lumber, shingles, and staves, window-blinds, sashes, and doors; wooden ware, including boxes, rakes, shoe-pegs, yokes, and helves, — make an aggregate of $1,881,589; the materials for almost the whole of which must have come from our forests. In the manufacture

[1] See Statistical Tables exhibiting the condition and products of certain branches of Industry in Massachusetts, for the year ending April 1, 1837, prepared from the Returns of the Assessors, by John P. Bigelow, Secretary of the Commonwealth.

of these, 2712 persons were directly employed. Probably five times that number depended on it for support.

If to this we add a fair proportion for the materials used in the making of boats, spars, pumps, and blocks, scythe-snaths, scythe-rifles, &c., brushes, brooms, and baskets, carriages, wagons, sleighs, harness, &c., machinery, ploughs, saddles, trunks, and whips, shovels, spades, forks, and hoes, reaching in all the sum of $2,952,317, giving employment to 3950 persons, and support to doubtless five times as many; and if the wooden materials be estimated at 1-10th part of the

final value, we have	$295,231
to add to the	1,881,589
found above;	———
making, in all, the sum of	$2,177,820

besides the value of the proportion of wooden materials entering annually into the building of ships.

The effects of the wasteful destruction of the forest-trees are already visible. A very large proportion of the materials for ship-building, house-building, and manufactures, in the towns along the coast, are now brought from other States. The manufacture of wooden bowls and other vessels made of a single piece has in some towns in Berkshire diminished, and in others been given up, from the failure of the ashes, beeches, lindens, and other suitable trees large enough for the purpose; and, in the western towns of Worcester county, materials less valuable than heretofore are necessarily, in some cases, used in the important manufacture of chairs. The same thing is taking place, almost imperceptibly, in all parts of the State. Every mechanic who works in wood looks every year more and more out of the State for his materials. Every year we are more dependent on Maine and New York, and some of the Southern States, not only for ship-timber and lumber for house-building, but for materials for tanning and dyeing, for carriage-making, basket-making, plane-making, last-making, and for furniture and the implements of husbandry.

Even these foreign resources are fast failing us. Within the last quarter of a century, the forests of Maine and New York, from which we draw our largest supplies, have disappeared more rapidly than those of Massachusetts ever did. In a quarter of a century more, at this rate, the supply in many places will be entirely cut off.[1] In many parts of both those States, which recently furnished the most abundant supplies, agriculture is already taking the place of the lumber trade; and the disforested region, now changing into beautiful farms, will never be allowed to resume its original wildness; or, if the attempt should be made to restore the forests, the experiment would require a hundred years.

8. Another special use of the forests of the State is in the production of maple sugar. Great quantities are already made, and the manufacture might be much more generally introduced. This subject has already received considerable attention. It deserves much more. In many favorable situations, the cultivation of the sugar-maple tree would cost only forethought. The labor of planting the trees might be performed late in the year, when the fall work was over, and the making of sugar be attended to early, before the spring work had begun.[1]

Of minor importance, but of much more than is usually given to it, is the production of nuts of various kinds, — the fruit of forest-trees. The produce of the shellbark, chestnut, beech, hazel, and acorn, already valuable, might be increased in value almost indefinitely, by selecting the best native varieties, and improving them by processes similar to those to which we owe the fine varieties of apple and pear, and the cultivated varieties of European nuts, and by introducing similar trees, — such as the pecan nut, the English walnut, and the European hazel.

9. The most extensive and important use of the forest is in the fuel it furnishes. Many of the fires, in the homes through

[1] These predictions are sadly fulfilled.

[2] The surpassing beauty of the tree ought, itself, to act as a strong inducement to planting it.

the State, are still chiefly fed from this source. The population, by the last census, was something over 737,000. Now, it has been found that in England, the country most like ours, a family consists, on an average, of $4\frac{7}{10}$ persons. From the greater facility of procuring subsistence, marriage takes place earlier among us and families are larger.[1] If we suppose them to average six persons, there are about 123,000 families in this State. If we suppose the average to be seven, there are more than 105,000 families. The prices of fuel vary very considerably in different parts of the State. The estimates of value that have been sent me, give not far from four dollars as the average price per cord of hard wood. The quantities required for a family's fuel for a year, are very variously estimated. The medium is between 13 and 14 cords. If we suppose the price to be only $3.50, and the quantity required for a single family to be only 12 cords a year, the average cost of fuel for each family will be found to be $42. If there are 123,000 families in the State, the annual expense will be $5,166,000. If we suppose only 105,000 families, the expense cannot be less than $4,410,000. It would not be easy to ascertain the quantity of fuel used in the schools, workshops, and furnaces in the State.[2] The quantity consumed in the locomotives on the railroads is vastly greater, a very large part of which might be saved; and a large portion of the coal which has been introduced to take the place of wood might give place to wood.

[1] A fearful change has taken place since this was written both in the age of marriage and the numbers in a family.

[2] Very many families who used, when the above was written, wood only for fuel, now burn coal. But coal is yearly more and more expensive, and proper care of the forest might save all this expense.

CONTINUATION AND IMPROVEMENT OF THE FORESTS.

From all these considerations, it is apparent how valuable are the forests, and how important it is that efforts should be made, by the land-owners of this generation, to check the waste which is going on, and to provide supplies for the wants of the generations to come. Planting trees on a large scale has been seldom attempted in New England. The inhabitants of each town have been content with the kinds of wood growing in their neighborhood; or, where particular kinds, not to be found there, were necessary for the manufactures already established, they have been satisfied to import them from a distance. In very few instances have systematic efforts been made to provide a future supply of the best materials, in their own immediate vicinity. This is to be done. The individuals interested in a particular branch of manufacture in wood may say that, when materials fail them in one place, they will go to another. The owners of the land ought not to rest satisfied with this view of the case. True patriotism and enlightened views of economy ought to prevent any one from consenting to it. Read what Mr. Marsh says: —

"The objects of the restoration of the forest are as multifarious as the motives that have led to its destruction, and as the evils which that destruction has occasioned. It is hoped that the planting of the mountains will diminish the frequency and violence of river inundations, prevent the formation of torrents, mitigate the extremes of atmospheric temperature, humidity, and precipitation, restore dried-up springs, rivulets, and sources of irrigation, shelter the fields from chilling and from parching winds, prevent the spread of miasmatic effluvia, and, finally, furnish an inexhaustible and self-renewing supply of a material indispensable to so many purposes of domestic comfort, to the successful exercise of every art of peace, every destructive energy of war." [1]

[1] Marsh, *Man and Nature*, p. 292.

Massachusetts must necessarily continue to be a manufacturing State; and the manufactures in wood are among the most important branches of industry, and must be not only continued but enlarged. They cannot even continue, unless pains are taken to plant forests which shall furnish the necessary materials. A manufacturer of wooden bowls and trays in Boston, who had procured his materials from Maine, found that it would be better economy to live near the woods which produced them, and send the finished articles thence to market. When the large ashes and beeches of Becket are cut down, the maker of wooden ware must remove to an older forest. What takes place in individual cases, indicates the necessary but silent movement of great masses. One by one, the workers in wood will have left the State, when the old forests shall have been all cut down. A prudent foresight may prevent this, by planting, in season, the kinds of trees necessary for these various demands, — for fuel and for all the branches of manufacture. For this end, we have extraordinary resources. Among the native trees, we have great choice, from the number, variety, and excellence of the species. In the narrow breadth of Massachusetts, the species of native timber trees are more numerous than are found in any kingdom of Europe. We have nine large oak-trees, four hickories, five birches, three large maples, three ashes, three pines, two walnuts, two elms, two spruces, two cedars, besides the beech, the chestnut, the hornbeam, the lever-wood, the tupelo, the hoop-ash or nettle-tree, the tulip-tree, the plane, the bass, the locust, the hemlock, the fir, the hacmatack, the cherry, the holly, several poplars, many willows, and a large number of smaller trees. Besides these, it is found that all the valuable trees of middle and northern Europe flourish here as if they were native, and, in some instances, even surpass our native trees, in the rapidity with which they grow. It thus appears that our soil and climate are perfectly well adapted to all kinds of wood which are found in temperate

countries. It is only necessary to understand the character and habits of each, and to choose suitable soil and situation.

Of many of our trees the properties are but partially known. Some of them grow only in particular districts. Others are so unlike those found in the mother country, that they hardly have a name.[1] Of many, the habits and rate of increase, and the soil, exposure, and situation most favorable to their growth, have not yet been studied. Of the nine large oaks found growing in Massachusetts, not more than five are often found in the same forest, and of these, two, and often three, are not well distinguished by the land-owner, though their value for different purposes is very different. The black oak and the scarlet are commonly confounded, from their close resemblance, although, to the ship-builder or the wagon-maker, the former is far the more valuable; and both these trees are often confounded with the red-oak, which, for timber or fuel, is comparatively worthless. The rock-chestnut oak, of great value for fuel and for timber, and better adapted than any other oak for growth on rocky hills, is well known in only a few towns in the State. The mossy-cup oak, so valuable for trenails and small frame-work, is found only in a small part of Berkshire. It would grow readily in any section. The rough-oak, or post-oak, is now known only on Martha's Vineyard, and in parts of Plymouth and Barnstable counties. Similar observations might be made on half the trees in the State. Those most interested in the subject, the owners of the land which should be devoted to trees and the mechanics who work on the wood, are seldom acquainted with the qualities of any except the trees of their own immediate vicinity.

Nature points out, in various ways, and the observation of practical men has almost universally confirmed, the conclusion to which the philosophical botanist has come from theoretical considerations, that a rotation of crops is as important in the

[1] There is no one uniform name for the Celtis, the Carpinus, the Ostrya, or the Nyssa.

forests as it is in cultivated fields. A pine forest is often, without the agency of man, succeeded by an oak forest, where there were a few oaks previously scattered through the wood, to furnish seed. An oak forest is succeeded by one of pine, under the same conditions. But it frequently happens that there are not enough trees of the opposite family to seed the ground: in which case a forest will be succeeded by another of the same kind, which, though it will grow, will probably not flourish with the same luxuriance as would one of another family.

It will not be considered foreign to our purpose to enumerate some of the more important of the objects which should be kept in view, in the cultivation and extension of our forests, and the native and foreign trees best suited for those purposes.

The first want, as has been shown, is fuel. The trees best suited to the purpose are the hickories, the oaks, the beech, the birches, the maples, and the pines, particularly the pitch-pine, and the chestnut and hemlock for close furnaces. If fuel is to be used in the form of charcoal, the hard woods only are of great value, particularly chestnut, the birches, alders, oaks, and maples. As materials for house-building, the pines, the spruce, and the hemlock are generally employed. White-oak was formerly used for frames, and in many houses now standing for more than a century it has not begun to decay. Chestnut resists decay, and is more and more in use. Floors are sometimes made of beech, of birch, and of ash. For ornamental finishing, these woods and the tulip-tree, Southern pine, walnut, hickory, maples, bass, and various kinds of oak, commend themselves. The best materials, probably, are oak, white-pine, chestnut, and spruce.

For ship-building, oak is considered absolutely necessary, as being preferable to any other wood. The best kinds are white-oak, and black, or yellow-bark oak. Much Southern oak is now used. The English oaks, which, in Great Britain, are preferred, may be cultivated here at least as successfully as

our own oaks.[1] In the construction of most of the ships of Europe, great quantities of larch are used. This tree might be profitably planted on thousands of acres which are now unproductive. Small vessels, remarkably light and durable, have been wholly made of pitch-pine. This tree grows well on sands so barren as to furnish nourishment for no other tree. Pitch-pine is also used in preference to other timber for the upper works of large vessels, and for top-masts. White-pine is also used; especially for decks, as it retains the oakum in its seams; and for knees, hacmatack and spruce; and rock-maple for keels. The durability of all kinds of wood under salt water is considered nearly or quite equal. Spruce and pine are also used for the upper spars. For boats, cedar and oak are necessary.

For fencing materials, chestnut and cedar are found most durable. The former is remarkable for its rapid growth. White-cedar grows luxuriantly in wet swamps where nothing else will flourish. The various native and foreign thorns, the hemlock, red-cedar, and numerous small trees, furnish fit materials for hedges, which, in many parts of the State, must ultimately take the place of other fences.

Furniture, of the most ornamental kinds, is now made of our beautiful maples, birches, cherries, and beech. Tables of extreme beauty are sometimes made of the root of oak, or maple, or birch. These four trees, with the oaks and pines, must continue to be indispensably necessary for the manufacture of chairs, tables, bedsteads, and other kinds of furniture.

For implements of husbandry, the ashes and hickories, the lever-wood, the hornbeam and the oaks, must always be wanted. The carriage-maker and wagon-builder will want ash for springs and frames, oak for spokes and fellies, elm for hubs, and white wood or bass for panels. The basket-maker will want young white-oaks, ash, and willow; the plane-maker,

[1] This statement has been abundantly confirmed by the cultivation of European trees on poor land, in exposed situations on the coast.

beech; the last-maker, maple; the pump-maker, oak, tupelo, and pitch-pine; the bucket-maker, white and red cedar. The tanner will continue to want the bark of the black, the white, and the chestnut oak, the hemlock and the birch, in the use of materials from all which there has hitherto been great wastefulness. And the dyer will want quercitron, sumach, barberry root, in addition to foreign stuffs, for some of which he might substitute the bark of alder, birch, and some other native trees.

On nearly every farm in Massachusetts, more land is under cultivation than can be profitably managed. Many acres now in tillage might, with great advantage, be turned into forest, and the labor and manure which have been spread upon them, be used in the better cultivation of the remaining acres. All that portion of every farm which is hilly or very stony, and all that does not readily bear good crops of corn and grass, may be, at comparatively little expense, sown with the seeds or set with the young plants of the most valuable forest-trees. The sowing or the planting should be very liberal; the young trees, when close together, protecting each other, and the poorer ones, when the plants become too close, affording excellent fuel, and serving, as they grow large, many important purposes.

In this way, a valuable, permanent wood-lot might be added to farms the owners of which are now obliged, at large cost, to get their fuel from other sources.

It is poor economy to allow old, worn-out fields to stock themselves with the trees of the neighborhood, seeds of which will usually be found in the ground. These will generally be the poorest trees. But wherever a gray birch will flourish, the valuable birches — the paper, the black and the yellow — will grow; and where the pitch-pine springs up, will most of the trees of the pine family.

Whoever intends, by this means or in any other way, to form or restore a forest, ought to furnish himself with some

book showing the course that ought to be taken with the different kinds of trees.

IMPROVABLE LANDS.

For all the above purposes, the forests are of vast, immediate, and prospective importance. A knowledge of the best and most economical means of managing and enlarging them is no less important.

According to the latest returns, the woodlands of Massachusetts cover 729,792 acres. There are, besides, 955,000 acres of unimproved lands, and 360,000 reported as unimprovable. In all, there are 2,044,792 acres not occupied by buildings or cultivation, out of the 4,491,812 acres which are estimated to constitute the whole territory.[1] Probably the whole of the unimproved and those called unimprovable lands might be turned into forest; as it is very questionable whether any land, except the ocean beach, should be considered unimprovable. The least promising kinds of surface are that covered with loose, drifting sand, that of bare, rocky hills, and that of marshes covered with sedge.[2]

The most barren sands along the sea-coast of France have

[1] In 1865 there were, according to the returns, 1,937,378 acres of improved land, 1,030,925 acres of unimproved land, and 282,439 acres of unimprovable land.

[2] Trees and bushes prevent the drifting of snow and sand; and certain species conduce to the covering of barren, sandy plains with grass. For this purpose the locust, Robinia pseudacacia, one of the "nurse trees of the world," as Evelyn calls them, seems peculiarly adapted. By the planting of this tree, the author has seen rolling sand-hills covered with a soft green turf. The method of planting is to begin upon the most exposed side of the sand barren, and cover what is to be planted at the time with brush or any kind of coarse litter. This prevents the sand from blowing at the commencement; and, as it decays, forms a coating of manure for the young trees. "If the locust seed is to be sown, scalding water should be poured upon it, and it should be allowed to stand in a warm place for three or four days. It should then be sown in the interstices of the brush, and covered with sand or soil to the depth of one or two inches. Of thousands planted in this way, not one has failed." — *American Agriculturist*, as quoted by Dr. Piper, *Trees of America*, p. 512.

been successfully sown with pines. Of the details of the process, an account will be given in the chapter on trees of that family. No part of the sandy territory of Massachusetts is so hopeless as the region in France which has thus been actually converted into forest. Our climate is quite as favorable as that of France to the growth of evergreens. We have, among our native trees of that family, a much greater variety; and we may avail ourselves, if necessary, of the very kind of pine so successfully experimented upon in that country, the sea-side pine, Pinus maritima; and the Scotch fir, Pinus sylvestris, which is found to be, in Massachusetts, on barren soil, exposed to all the winds from the sea, more hardy than the pitch pine or the white, promises extremely well.

Many acres now under cultivation, and poorly repaying the labor spent on them, might be advantageously sown or planted with pines.

The most impracticable of our rocky hills were originally covered with trees. Sufficient portions of them remain in that state to show that all might, with a little pains, be redeemed to a productive use. There are several kinds of trees which require very little soil; some of them need little more than a foothold in the earth. Several oaks, birches, and pines are often found growing among rocks where no soil can be seen. The rock-chestnut oak, the black-birch, the red-cedar, and the hacmatack rejoice in such situations. As in the case of the sands, the experiment has been made, on a large scale, of covering bare, bleak hills, with trees. Of the Duke of Athol's successful experiments in Scotland, on thousands of acres of worthless, rocky hills, an account will hereafter be given, as also of the value of the forests thus created.

Of sedgy marsh and swamp, too wet and cold to be cultivated without extensive and costly draining, many acres, in the eastern part of the State, have been sown, by a natural process, with the seeds of the white-cedar. The seeds, when shed, float upon the water, and are carried by spring-tides and

freshets, and left upon the surface of the ground. In the summer, they spring up in countless multitudes. They may now be seen in different states of forwardness, some of them forming impenetrable thickets. What has been done, in these instances, by nature, indicates the process by which similar grounds may, by art, be reduced or restored to the condition of forest.

By means of the trees above mentioned, and others, almost every acre of the surface might be made productive. Even the rocky crown of the sea-beaches might be covered with beach plums, pine-trees, and birches.

Much is to be done for the improvement of the woodlands now existing. In some cases, they are managed with great care. The best means of thinning, pruning, and felling are studied and practised. But, in many cases, — indeed, in most instances, — they are left in utter neglect. The consequences are often very visible. In the cedar swamps just spoken of, the natural seed-sowing has been so profuse that plants spring up thick enough to almost cover the ground. Ten or twelve may sometimes be seen on a square foot. These grow up well together for a year or two. Afterwards, they seem to be struggling for existence. The growth of all is retarded — almost stopped. In a few years, the strongest overtop the others, which gradually die. Still the number left living is far too great for the ground, and few of them become fine and vigorous trees. All the side branches die for want of light and air, and the topmost shoot, never sufficient to form a shapely tree, is left alone. The same thing takes place in beech groves. Ten or twenty times as many plants spring up as can be sustained. They go on together vegetating, but hardly growing. I know instances of beech woods which have made little perceptible progress for twenty years. These are the most striking cases; but forests of other trees are almost constantly, if left to themselves, affected in a similar manner.

The remedy is obvious. Every year, from the first, they need to be thinned. For the first few years, the plants removed are of no value except for transplantation or fuel. Afterwards, they are of use in innumerable ways; the young cedars, larches, and chestnuts, for stakes and poles; hickories, for walking-sticks; oaks and ashes, for basket-work; lever-wood and hoop-ash, for whip-stocks and levers; all of the five latter, for hoops. The products of the thinning will thus obviously far more than repay the labor, even if this were not necessary for the welfare of the remaining trees.

THINNING AND PRUNING.

The *principle* on which pruning and thinning should be conducted is a very plain and intelligible one. It is that every tree and every branch should be allowed to have an ample supply of air and light. When, therefore, two trees are so near that their branches extensively intermingle, one should be removed; and, generally, it should be that one which is much taller or much shorter than the neighboring trees.

In pruning, that branch should be shortened which encroaches on other branches of its own or another tree. It should not be cut off close to the stem, as, in that case, the wound will be long in healing, and the root[1] which supplied the branch, being left useless, will wholly or partly perish, and, by its decay, will infect and weaken the whole tree. It should rather be taken off at the distance of a foot or less from the stem, just above a vigorous shoot, which shall be left to grow towards a space in which it will find a plentiful supply of air and light. The shoot thus left will sustain the life of the

[1] It is almost universally found, that a large branch corresponds to a large root, and the reverse; and this is true, whether the root, placed in favorable circumstances, determines the growth of the branch above it, or the branch, propitiously situated, causes the growth of its corresponding root." — De Candolle, *Organographie Vegetale*, Tom. i., p. 162.

shortened branch, and will continue in action the root by which it had been nourished.

The mode of thinning and pruning will be governed in some measure by the end in view. If the object is to produce a full-grown tree in its true character, developing itself according to its natural tendencies, all or most of the branches will be left, and care be taken to give them space; and, as every leaf of every branch swells the trunk, a similar course will be pursued where it is an object to get the greatest possible amount of wood. In both cases, only those stems and branches which interfere with the rest will be removed. A crowded growth will be allowed, and the lower lateral branches will be removed, where it is desirable to get a lofty trunk and head.

In many hard-wood trees, shoots spring vigorously from the stool or stump, after the trunk is cut down; and this mode of reproduction is chiefly relied upon in most of the woodlands in the State, as it is in the coppice woods in every part of Europe. It becomes, then, of great importance to ascertain what are the best modes of felling, whether by thinning out the forest, or cutting it entirely down; in what period a wood, so cut down, will renew itself, so as to be profitably cut again; at what age of the tree the stump will shoot most vigorously; at what age, if any, trees cease to shoot from the stool; what trees will not thus shoot; what season of the year is found best for felling a forest, when the object is to have it renew itself speedily; and what season, when the object is to destroy the forest. In 1838, I addressed circulars to gentlemen interested in the forests, in all parts of the State, asking these questions and others. In answer, I received many communications, from which I now proceed to extract some of the valuable conclusions of the observation of intelligent, practical men. Most of these conclusions are confirmed by the concurring testimony of great numbers of persons.

The ninth question in my circular, was, "In felling for tim-

ber, or for fuel, is it the practice to thin out the forest, or to cut it entirely down, and leave it to spring up from the stumps? Which is considered preferable?"

From the answers returned, I find that, in felling for timber, the practice is to select suitable trees, from any part of the forest. No instances have come to my knowledge of extensive woods cultivated with express reference to the production of timber. In felling for fuel, the practice *has been* to select the old and mature trees, especially such as have begun to decay. It has now become nearly a universal practice to cut clean and close. Experience has uniformly shown this to be most economical. Several of my correspondents have subjoined the reason. One of them[1] writes: "Trees which remain where woods are thinned, are much shaken by the winds, and often destroyed. Again, unless the timber be all or nearly all taken off, the new growth is shaded, sparse, and feeble. But where a new forest springs up, it accommodates itself to all circumstances of wind and tempest." Another[2] says: "Some persons in this town have trimmed up young white-oak and walnut (hickory) woods, clearing the undergrowth, when the wood itself consisted of young shoots of 10 or 12 years of age. The result of this experiment does not seem to justify a continuation of the practice." Experience here seems to confirm a well-known principle, that the quantity of wood formed depends upon the number of the branches, or rather upon the extent of surface of the leaves. To the question,—"How soon will a wood, which has been cut entirely down, renew itself so as to be profitably cut again?" the answers are very full and satisfactory, though very various. The object is everywhere supposed to be fuel. Some give a definite period, varying, for different places, from 15, 17, 18, 20, to 25, 30, and 35 years. The average of ten such is 23 years. Others speak less definitely, from 15 to 20,

[1] William Bacon, Esq., of Mount Osceola, Richmond.

[2] Austin Bacon, Esq., of Natick.

17 to 30, 20 to 25, 20 to 30, 20 to 33, 20 to 40, 25 to 30, 25 to 35, 30 to 35, for woods of miscellaneous growth. The average deduced from fourteen such statements, is, from 21 to 28. The general average from all is a little over 24 years. These statements are probably as definite as the case admits. Differences of situation, exposure, soil, and kind of trees, would of necessity lead to them. For particular trees, the answers are more precise. The white or gray birch is of most rapid growth, and springs at once from the stump. This may be profitably cut in from 10 to 20 years; a growth of maple, ash, and birch, black, yellow, and white, in 20 to 25; oaks, in from 20 to 33. Where the trees are principally oak, white, black, and scarlet, the forest may be cut clean three times in a century. Cedar swamps which grow from seed cannot be profitably cut in less than 40 years. Pitch-pines which also spring only from seed are very slow at first, and require from 40 to 60 years to be in a condition to be felled. In many places, the experiment has been tried of burning over the surface, ploughing, and sowing with rye. When the trees have been of hard wood, this practice is strongly condemned. In the case of the pitch-pine, it is recommended. The seedling pines make much more rapid progress when the surface has been softened by cultivation.

An intelligent gentleman of great experience, A. M. Ide, Esq., of South Attleborough, gives me a statement of some important facts bearing upon the subject. "Having been, for thirty years past, more or less engaged in buying woodland and cutting it off, I wish to state that I know, from careful observation, that an acre of good land, where there is a mixture of the several kinds of oak and walnut (hickory), cut off while young and thrifty, will produce, during the first 20 or 25 years, a cord of wood yearly." "I believe that most kinds of hard wood are worth twenty or thirty per cent more for fuel at the age of 25 years than at 75." This important fact is confirmed by many of the wood-growers in the Old Colony,

and in other parts where the woods have been repeatedly cut down. It is remarkable that all the facts and testimony lead to the same conclusion. The trees best for fuel shoot again most readily and vigorously when cut under 25 years. The wood is formed within that time as rapidly, taking a forest together, as at any other age; and, for fuel, it is then of most value.

In cutting with a view to future timber, the tree should be felled as close to the ground as possible, as the shoots will then be erect. In cutting with a view to fuel, it is of less consequence. Several suckers will be thrown out, all of which will be curved at base, but they will all, thereby, have more room to grow.

To the questions, — "Stumps of trees of what age, when felled, will shoot up most vigorously? Is there any age at which they cease to shoot? What trees will not shoot from the stump?" the answers are equally full. To the first of these questions, the uniform answer is, that the stumps of young, healthy, growing trees, shoot most vigorously. They should not be under 15 years, nor much over 20. The almost uniform answer to the second question, is, that shoots will not come from very old trees. From those of old trees they spring up, but die in one or two years. Stumps of trees that had begun to decay, seldom give any shoots. In some cases, suckers come from the roots of old trees, but not from the stump. A single individual thinks that the power of throwing up shoots from the stump, never ceases during the life of the tree.

As to the third question, all agree that evergreens never give permanent shoots from the stump. Several persons who have attended to the growth of the sugar-maple say, that the stump of this tree makes no shoots; and the same is said of the beech. This is, however, contradicted by some careful observers, in regard to the sugar-maples, "which sprout from

the stump as freely as any other tree, when cut at a moderate age."[1]

As to the season of the year most favorable for felling a forest, when the object is to have it renew itself speedily, the testimony is various, but not absolutely discordant. All agree in saying, that the tree should be felled when not in leaf. The majority say, generally, in the winter months; some, between November and April. A correspondent in Plymouth, my friend, G. P. Bradford, who kindly took great pains to get information extensively from the wood-growers in that neighborhood, says, "It is generally considered, by those well acquainted with the matter, much preferable for the future growth to fell a forest in April and May. The wood is not so good as when cut between November and April." This is confirmed by several other persons who have enjoyed means of extended observation. The convenience of the wood-cutter will generally lead him to fell the forest in the early part of winter; and, probably, taking into consideration both the quality of the wood cut and the welfare of the future forest, this may be best.

When the object is to destroy the growth, summer is universally declared to be the best season to fell a forest. As to the month, opinions differ. Many say, August, or late in summer; some say, June and July, or midsummer. Mr. A. C. Metcalfe, a very intelligent farmer of Lenox, says, "In August, or when the tree has attained its full growth for that season." This seems to be the true period, at whatever time it takes place; when the wood is formed and before it has hardened, and before the materials are laid up in the trunk and root, for future growth. Mr. A. Bacon describes a conclusive experiment. "A gentleman residing in this vicinity effected the clearing of a lot of young walnuts (hickories), oaks, and birches, in the following manner. He commenced cutting about the first of March, and felled successive portions,

[1] Minot Pratt, of Concord.

as he found leisure, till about the first of July. That portion which was cut between the 18th and 30th of June was killed to the letter. Those which were cut before the leaves put forth were most prompt in the renewal of their sprouts."

I find an opinion very generally expressed or implied, that every tree has a period of growth, maturity, and decay. This is apparently hostile to the theory universally received by the vegetable physiologists, that the growth of every exogenous[1] tree is, by its nature, indefinite. The discrepancy admits of being easily reconciled. Throughout Massachusetts, in the land left in forest, the soil is thin and poor. It will, therefore, in a comparatively short period of years, be exhausted of the nutriment essential to trees of any particular species. Every tree, like every other organized being, must perish when deprived of its necessary food. It is not surprising, therefore, that, in many soils, the trees should at last be unable to obtain sufficient nourishment, and should consequently thenceforward begin to cease to grow, and finally perish from inanition. We do not find this taking place on our rich intervales, and it might everywhere, probably, be prevented by supplies of fresh, nourishing soil. The proper inference, therefore, from the fact that trees are dying on the ground, is, that their appropriate nourishment is exhausted, and that, if the ground is to be continued in forest, it should be sown or planted with trees of some other kind.

This is clearly indicated by what is constantly going on in the forests, particularly the fact which I have already stated, and which is abundantly confirmed by my correspondents, that a forest of one kind is frequently succeeded by a spontaneous growth of trees of another kind. Mr. P. Sanderson, of East Whately, writes me, "There is an instance, on my farm, of spruce and hacmatack being succeeded by a spontaneous growth of maple wood." Mr. Metcalfe, of Lenox, says, "A

[1] All the common trees of our climate are exogenous; that is, they annually form a layer of new wood between the old wood and the bark.

forest of beech and maple is now growing on my father's farm, where stumps of white-pine and some of oak and chestnut are very numerous and very large." Oaks and pines most frequently succeed each other. Mr. E. Swift, of Falmouth, writes, "Many instances have occurred in this town, of pine lands having been cleared of the pine timber, which has been succeeded by a spontaneous growth of oak." J. H. Cobb, Esq., of Dedham, says, "I have known pine succeeded by hard wood in several instances." Mr. S. Freeman, of Brewster, declares, "I have known frequent instances where a forest of oaks has been entirely cut down, and succeeded by a growth of pine, and *vice versa*." Mr. W. Bacon, of Richmond, writes, "We have seen hemlock succeeded by white-birch in cold places, and by hard maple in warm ones; beech succeeded by maple, elm, &c." I have many similar statements from all parts of the State. Indeed, the Hon. D. P. King, of Danvers, tells me that the fact is so universally admitted, that he is surprised at my asking the question.

This alternation is not, however, universal. In order that it should take place, the woods must contain trees of various kinds sufficient to supply the whole surface with seed. When this is the case, a wood of one kind will usually be found full of little trees of other kinds. "Upon clearing off the old growth, the undergrowth, which has been kept from the sun, shoots up with astonishing rapidity."[1] That portion of it which is most unlike the previous growth, finds plentiful nutriment, while the proper food of the previous forest has been exhausted, and the woods naturally change their aspect.

The forests, as has been stated, form or improve a soil. This they do by their annual deposit of leaves, and by rendering the ground accessible to air, by the action of their roots. Both operations are essential, and aid each other. If the leaves were not deposited, the surface of the ground would speedily become dry and hard, and the radicles which had pre-

[1] Mr. A. Bacon, of Natick.

viously pervaded it would be exposed to cold in winter, and to heat and drought in summer. The covering of leaves protects against all. By them the superficial portions are kept moist and soft, and permeable by the delicate radicles; and these are protected, while they are made readily accessible to moisture from rain charged with carbonic acid, and to air and a tempered warmth. The covering of leaves thus secures all those circumstances which are most favorable to vegetable growth. It is, therefore, justly enumerated, by some of my correspondents, among the things most unfavorable to the growth of trees, to gather the leaves together, as is frequently done, either to burn them or to add them to the compost heap. This is bad economy. It is double robbery. It is taking from the forest what belongs to it, and is almost essential to it, and it is spreading, with loss of time, upon the present cornfield, what, left undisturbed, is at once a storehouse and laboratory of manure for the future cornfield, on which it is already spread and spreading itself.[1]

The other circumstances enumerated as particularly unfavorable to the growth of trees, are browsing, pruning, a thin soil, exposure to sea breezes, to high winds, and to frosts.

The first of these, completely within the control of the forester, is the browsing of cattle. This is highly injurious to a forest in every state. It is destructive to the young trees, to the lower branches of taller trees, and to the undergrowth, which, in an old forest, is the hope of the future. Sheep and horses are not less injurious than cattle. All should be entirely excluded from woodlands intended to be valuable as such, and to renew themselves.[2]

[1] The removal of the leaves deprives the soil of that spongy character which gives it such immense value as a reservoir of moisture and a regulator of the flow of springs; and, finally, it exposes the surface roots to the drying influence of sun and wind, to accidental mechanical injury from the tread of animals, and, in cold climates, to the destructive effects of frost." — *Man and Nature*, p. 324.

[2] Where a forest is to be renewed artificially, and where the trees are out of the reach of cattle, there is no objection to their grazing among them. One considerable recommendation of the Duke of Athol's mode of redeeming lands by planting larches, is, that the ground is improved for pasturage by the growth of grass under the shade of the trees.

I have already spoken of pruning. Where the object is wood, it may be doubted whether any pruning is advisable, except in the case that a branch of one tree materially interferes with the growth of another. Plants receive food by their roots and leaves, and digest and convert it to their various products, by and in their leaves. Both roots and leaves should therefore be left to extend and expand themselves as freely as possible; the one to occupy all the space just below the surface of the ground, the other to gain all the air and light within their reach above. Whatever checks this free expansion, has a tendency to lessen the product of wood.

On thin soil, the roots cannot penetrate far, and a tree surrounded by others will soon exhaust the proper nutriment within its circle, and must then begin to fail. As soon as this happens, it must be removed, and trees of other families must be sown or planted in its stead. The proper treatment for thin soils, is, therefore, a rapid alternation of crops.

Most forest-trees are injuriously affected by the sea-breeze, and we generally find them stunted and dwarfed by its influence. The remedy is to plant numerously the hardiest trees along the seaward border. Those that most successfully resist the sea-breeze, are the plane-tree, or buttonwood, the linden, or bass, the poplars, — particularly the balm of Gilead, — and many of the pines. Almost all trees may do it when growing in large masses. The effect will then be less and less, — rapidly diminishing as you recede from the sea. On the capes and headlands projecting into the Atlantic, along the coast of Massachusetts and Maine, and exposed to the terrible north-east winds, the undisturbed original forests, when half a mile wide, have, in the middle, as large trees as are due to their depth of soil.

It is often very difficult to make trees begin to grow near the sea; sometimes it is impossible without protection. But a low wall of loose stones, seaward, is sufficient to protect young trees near it until they get a little higher than the wall.

The successive rows inland will be better and better protected, and will rise each higher than the preceding; until, at the distance of a few rods, they may rise to a respectable height. When a belt of trees is once established, in such a situation, it should be kept undisturbed as long as it will serve the purpose of protecting the trees within, though it may be of no other value.

A course altogether similar should be taken in planting a much exposed hill. By beginning at the bottom, and gradually planting upwards, the top may at last be clothed; as every belt of trees of a few feet in height will protect a younger one a little higher on the hill.

Wherever trees are planted for use in the arts, it is important to give them the most rapid growth possible. Of wood growing on the same soil, that which grows most rapidly is strongest. That of which the annual circles of growth are narrowest is also weakest. This fact is familiarly known to ship-builders, makers of lasts and of trenails, and of all those articles which require great strength. The reason is obvious. The circles of annual growth are separated by zones of loose, porous structure, and inferior strength.

The strength of wood is proportioned to its weight. And as young trees grow more rapidly than old ones, they are more valuable as fuel. Round wood of oak or maple gives more heat than that which is so large as to require to be split. This fact shows the wastefulness of burning on the ground the undergrowth and the trimmings, in clearing for cultivation or cutting for cord wood. Heart-wood is heaviest, and the weight diminishes on proceeding outwards to the surface, or upwards to the top of the tree, but much less in old trees than in young growing ones. The sap-wood of oak was found by Decandolle to fall short of the heart-wood in weight, in the proportion of six to seven.

It has long been known that summer or early autumn is the season most favorable for the felling of timber, where the

object is strength and durability. One reason why timber has not usually been cut at that season is, that most of those who fell trees are at that season occupied with their farming. The felling of trees is their winter employment. Nearly a quarter of a century ago, Timothy Pickering showed by experiments which he adduced, and by sound reasoning, that summer is better than winter for this purpose.[1] A writer in the "N. E. Farmer," [2] who "has wrought more timber than most men, and for more uses than any he knows of," says, he has found soft maple, cut in September, three times more lasting than ash or walnut cut in winter; that he has found the sap-wood of oak, cut in February and March, partly decayed in September, and the sap-wood of timber cut in May and June, decayed in a year, while the sap-wood of trees felled in September was perfectly bright and sound after two years; and that, from many observations he has made, he is satisfied that September is the best time for felling trees; and that if the tree be disbarked in June, and allowed to stand till September, the timber will be stronger and more durable. He has seen this proved with regard to elm, walnut (hickory), and maple, which are considered the most perishable of the trees used for timber. The same writer says,[3] that maple wood felled in June is liable to white-rot, while that felled in September remains sound in the same situation; and that timber felled in September will not suffer from red-rot or from powder-post. It seems reasonable, that a tree felled after the

[1] See Vol. I., No. 3, for August, 1822, of the "N. E. Farmer."

[2] Mr. Phineas Stevens, of Andover. Ibid., II., p. 370.

[3] Ibid., VI., p. 294. He subjoins a table of the comparative value of timber felled at the two seasons of the year mentioned, which he thinks correct or nearly so: —

Oak,	cut in September,	10.0 —	in June,	4.5
Maple,	,, ,, ,,	10.0 —	,, ,,	2.4
Walnut (Hickory),	,, ,, ,,	10.0 —	,, ,,	2.5
Elm,	,, ,, ,,	10.0 —	,, ,,	1.6
Ash,	,, ,, ,,	10.0 —	,, ,,	3.2

The four last, compared with white-oak, provided all were felled in September, will stand thus: —

Oak, 10.0 — Maple, 5.5 — Walnut, 6.2 — Elm, 4.5 — Ash, 5.6.

growth for the year is completed, and before the leaves have fallen, should have all its wood more mature, and should, at the same time, be prepared to be more easily and thoroughly seasoned than if felled at any other season. The evaporation which takes place from the surface of living leaves is very great. If, therefore, the tree is felled while the leaves are fresh, their evaporative action, which continues for some time after the tree has fallen, will speedily dissipate all the unappropriated moisture which the trunk contains. If, on the contrary, the tree is felled after the leaves have been shed, all this moisture must remain to be slowly thrown off by the usual process of drying. If, again, the tree is felled earlier in the season, while full of sap, and when the newly formed wood has not yet been ripened by the action of the sun, there must be much of crude and acrid juices, not easily to be got rid of, and many particles of immature wood, at least in the outer layer, which will render the process of seasoning slower and more uncertain.

There is much evidence to be found in books and in the experience of ship-builders, that sticks of timber cut in the end of summer, and seasoned only by this speedy action of the leaves, often out-last winter-cut timber which has had years of seasoning.

The naturalist, Buffon, after numerous experiments carefully made on a large scale, and continued through many years, arrived at the conclusion, that nothing contributes so much to the solidity, strength, and durability of timber, as completely stripping the trees of their bark, some years — at least three — before they are to be felled. This should be done in the spring, when the bark is most easily separable. The tree continues to put forth leaves, and to expand and mature them for several successive seasons. But as no new wood can be formed after the bark is removed, Buffon supposed that all the action of the leaves goes to add to the substance

of the wood previously formed.[1] It is thus increased in density and weight; and he found that, universally, in the same kind of wood, strength is proportional to weight. By this process, the sap-wood was rendered as dry, hard, and strong, as heart-wood, and in some instances even stronger. Timber managed in this way was found to be sometimes a fourth part stronger than that from trees in the same forest, and in all other respects precisely similar, treated in the usual way; that is, felled with the bark on, and dried under the open sky or under sheds.

Such are some of the suggestions which I have desired to lay before my fellow-citizens of Massachusetts, for the improvement of their forests and the redemption of their waste lands. I have opened, very imperfectly, the great and important study of the history and management of forest-trees. A tree is the most magnificent among the material works of God. The nature, the relations to soil, to climate, and to exposure, the affinities, the properties, and the uses to man and other animals, the dangers from enemies and diseases within and without, and the circumstances necessary to secure the health, growth, and beauty of the trees of any one family, are subjects worthy of the deliberate and mature and long-continued attention of any man, of whatever intelligence and with whatever resources of science. The best disposition of trees in the landscape, the treatment of each according to its character and appearance at all seasons of the year, so as to foresee and to produce the desired effect at every point which the eye can reach, and the adaptation of the various kinds of trees to the houses, churches, bridges, and other structures already existing or to be erected, and also to water, and to roads, — things evidently possible and yet indefinitely difficult, — to do all this successfully is the province of an art, which well deserves to take its place in the front rank among

[1] This it probably does by appropriating the substance destined for new layers of wood, to lining and filling up the cells or tubes of which woody fibre is composed.

the fine arts; whether we consider the science, taste, and skill which it calls into play, the vastness of the scale on which it acts, or the grandeur of the end which it has in view.

But why should it be thought important to reclaim or render valuable the waste or worthless lands of Massachusetts? There are millions of acres of land in the Western States far richer than any in our State, which may be purchased for much less than it will cost to render barren land productive. Why not go thither and occupy the rich wild lands? For many reasons. This is our native land. It is painful to break the chain of affection which connects us with it. It is painful to separate members of the same family. Every improvement in agriculture, in the management of the forests, and in the use of the other natural resources of our State, makes it capable of sustaining a larger population, and thus enables more of our young men and young women to remain with us, rendering home dearer to those who would otherwise be left behind. The advantages of our life, in the long-settled parts of the Bay State, are greater than can be expected, for more than a single generation to come, in the newly settled regions of the valley of the Mississippi or in any other new region. There are still higher reasons. We live in a climate and on a soil best adapted, from their very severity and sterility, to bring out the energies of mind and body, and to form a race of hardy and resolute men. We have our churches, our schools, our lyceums, our libraries, our intelligent and virtuous neighbors, — dearer to us than any strangers can be. These we are not willing to leave. We wish that our children should grow up under the influence of the institutions which our forefathers have formed and left to us, and which we have been endeavoring to improve. Here we wish to live and to die; and, when we die, we wish to be surrounded by those who are most dear to us.

In representing, by engravings, the trees of Massachusetts, I have been desirous of giving some idea of the families to which they belong, and of their appearance when grown; and, for this purpose, have selected, wherever I could find them, figures of the allied European trees, as they grow in their native forests, often made up, in a considerable degree, of trees of one kind. Thus may be given, better than in any other way, some conception of what will be the appearance of our trees, when they shall be cultivated in large numbers. The best old trees, of all our native kinds, have been long ago destroyed. Our ancestors have had no reverence for trees. All the best, grandest, and most beautiful have long ago been sacrificed. I have seen, in an hour's drive, in various parts of England, more numerous and finer trees than I have seen, excepting the American elm alone, in all New England.

Our species of trees are far more numerous and various than are found in any part of Europe. When the same care and taste shall be found in the preservation or cultivation of our trees that is everywhere seen in Great Britain, some future historian of our trees may take figures of all his best specimens from our own arboretums or forests.

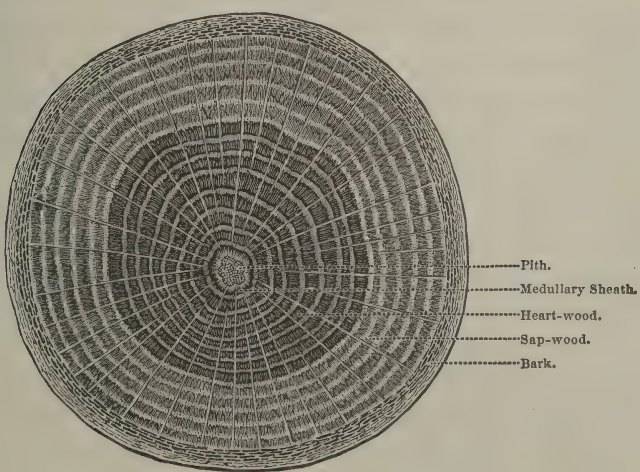
THE WOODY PLANTS OF MASSACHUSETTS.

FIRST GENERAL DIVISION.

DICOTYLEDONOUS PLANTS.

THIS division is far the largest and most important in the vegetable kingdom. To it belong nearly all the woody plants of temperate and cold regions. Dicotyledonous plants are distinguished by the structure of the wood, the structure and arrangement of the vessels and leaves, and especially by the structure of the seeds. The trunk in woody plants is composed of, 1, a central pith or medulla, which does not extend into the root; 2, of a ligneous medullary sheath, enclosing the pith; 3, of wood arranged in circles, or zones, the inner ones of which are called *heart-wood*, and the external, usually of a different color, *sap-wood;* and, 4, of bark, consisting of the inner bark, which is somewhat woody, the outer

Cross Section of a Black Oak.



bark, composed of a green layer and a corky layer, and the epidermis, or skin. From the pith radiate on every side, horizontally, vessels called medullary rays, the silver-grain of wood, which extend through the wood and bark. The action of the pith upon the bark is unknown, but much of the beauty of the wood depends upon this silver-grain. Linnæus conceived that from the pith was formed the seed, from the wood the stamens, from the inner bark the petals, from the outer bark the calyx, of the flowers. The heart-wood is the perfectly mature wood, a single circle attaining maturity, in temperate regions, every year. It is almost always of a different color, and of greater solidity, than the sap-wood. The wood is formed by the annual addition of a new zone or layer outside and encircling the older wood, and between it and the bark. This new zone consists essentially of woody vessels extending from the leaves to the extremities of the roots, and of the silver-grain or medullary rays, which traverse it horizontally on their way to the bark. It is called sap-wood because it is permeated by the sap. From the sap-wood of the sugar-maple is drawn the sap of which maple sugar and maple syrup are made. If one of these circles is carefully examined with a magnifying glass, it is found to be made up of little vessels, or tubes, which are larger as they are nearer the centre of the stem. If we carefully follow these vessels, which form the substance of every circular layer, we find that they always come from the base of a leaf. We find, also, that those which come from the upper leaves cover the previous ones, and that they all extend to the extremities of the radicles. It follows from this structure that the last year's growth completely covers those of previous years, roots as well as stems; and each year's growth is thus outside of those of every previous year, forming a double cone, largest at the junction of the stem and root. A new zone of bark is at the same time formed between the new wood and the previous bark. The former exterior coats of bark are forced to expand, to make room for the newly-

formed wood and bark; and, when expanded to their greatest capacity, the external layers yield, crack, and open, causing the rugged, ridged, and furrowed appearance common in bark on the trunk of old trees.

In stems of one year's growth the pith is seldom circular, but more commonly star-shaped, — in the oak, of five rays; in the birch, of three. It is made up of simple cells, which, in a shoot of more than one year's growth, is dry and sapless; and when — as is usually the case — it is of a white color, it resembles, from the brilliancy of the dry cell-walls, very fine dried soap foam. In old trunks these cells become filled or compressed, and form part of the solid wood.

In the poplar, and other trees of white wood, there is little difference in color between the heart and the sap wood. It sometimes happens, in thin-barked trees standing by themselves, and thus exposed without protection to cold and heat, that a spell of very cold weather, coming when the woody circle is almost completely formed, freezes it, and thus much diminishes the value of the whole future trunk. It also sometimes happens, to trees similarly exposed, that trunks full of moisture are suddenly cracked from the centre to the outer bark, marks of which are exhibited on the surface.

The rounds of growth exhibited by horizontal cross-cuts, except in the midst of a deep forest, are rarely circular, but are on the side which is most abundantly nourished by the roots sometimes more than twice as thick as on the opposite.

The bark is made up of four parts, — the liber, the cortical layers, the epidermis, and the layer beneath it. The liber is the layer next the sap-wood, and is composed of thin, delicate, very tough layers, lying one on another, like the leaves of a book, — in Latin, *liber*, from which it receives its name. These leaves are formed of a network of tubular vessels, each of which comes from the base of a leaf, and extends to the extremity of a radicle; those from the upper leaves ar-

ranging themselves within those previously formed, the reverse of what happens in the newly-formed wood.

The meshes between the vessels are filled with a substance like that of the pith. The great toughness of some barks, as of our basswood, is in the bast-cells, as they are sometimes called. The cortical layers, or true bark, are the old dried layers of the liber, which are, in most trees, broken into irregular portions, the whole forming a protection to the liber and the wood. The inner, more delicate layers, are green; the outer, the oldest, are variously colored; and, seen through the epidermis, give the various colors which we see in the recent shoots of different trees. The epidermis, or scarfskin, is a membrane, made up of tough empty cells, which completely covers every part of the plant, even the leaves and flowers, excepting only the stigma. Its nature is most conspicuous in the bark of the birches.

The leaves of dicotyledonous plants are usually jointed or articulated at base to the stem, or they are composed of several jointed leaflets, and are netted and feather-veined, the ribs and veins branching and running into each other; while the leaves of monocotyledonous plants are without joints, and have parallel ribs and veins, which do not thus intersect.

The essential part of the seed of a dicotyledonous plant, the embryo, is composed of two cotyledons, united by a neck or collar to a radicle or future root. The cotyledons are the seed-leaves, which, after the germination of the seed in the earth, usually expand upon the surface, as is conspicuously the case with the beech and the bean. Between these seed-leaves or cotyledons rises the plumule, the ascending axis, the future stem of the plant. Below them shoots downward the radicle, the descending axis or root.[1]

[1] The elementary substances essential to the structure of all plants are carbon, hydrogen, oxygen, and nitrogen. These enter the plant through the roots, which find them in the soil, and through the leaves, which take them from the atmosphere. The most important of these elements is carbon of which wood

almost entirely consists. This enters plants in the shape of a gas, carbonic acid, that is, carbon combined with oxygen; and the greater part of every rich soil is made up of carbon in a state called humus. Hence the wastefulness of burning up the leaves and branches, which are mostly made of carbon, and by the decay of which the soil is made fertile.

When burnt, the carbon, together with oxygen and hydrogen in vapor, escapes into the air in the form of smoke, leaving nothing but a little ashes. These consist of or contain potash, soda, lime, magnesia, alumina, and silica, which are thus shown to be essential elements in the structure of plants; besides which, the chemist obtains, from different plants, sulphur, phosphorus, and some other elements, — iron, manganese, chlorine, iodine, and bromine.

The student who would make himself familiar with the nature and structure of plants, must study books upon elementary chemistry and botany, especially Dr. Gray's *Introduction to Structural and Systematic Botany*.

WOODY PLANTS OF MASSACHUSETTS.

DISTRIBUTION INTO FAMILIES AND GENERA.

BY means of the following analytical arrangement, the name and the place in the volume of any plant described, may be readily found. Each line is a question to be asked in regard to the plant whose description is sought. In case of an affirmative answer, the reader is referred by the Arabic number at the end of the line to the next question, which will be indicated by the same number at the beginning of a line. By pursuing this course, he will be finally referred to the place of the family and genus where the description is given. The Roman numbers refer to the family; the Arabic numbers, which follow the Roman, refer to the genus under that family.

A few words of explanation are necessary to enable the reader to understand the arrangement of the table and the language used in reference to the flower and fruit.

Flower of the Apple.

A complete flower, the apple blossom, for example, is composed of, — 1, an empalement or calyx of one or several leaves, called sepals of the calyx, which, before the opening of the flower, completely covers and protects it; the sepals sometimes falling soon after the opening of the flower; sometimes permanent, and acting as a protection to the seed or other fruit; 2, within these, of the flower leaves or petals of the corolla, usually colored of some other color than green, the shapes and colors of which give its conspicuous beauty to the flower; 3, of one or more stamens, thread-like filaments, crowned by anthers which contain the fertilizing dust or pollen, which, when mature, comes out through long or round openings; and, 4, in the centre of the flower, of one or more pistils, which are made up of the ovary or vessel containing the ovules, or future seeds, surmounted by a stigma, which is often supported by a slender column called a style. It is supposed that the pollen, which falls from the anther upon the moist stigma, penetrates through the hollow style to the ovules in the seed-vessel, and enables them to become fruitful seeds. A perfect flower is one which contains both stamens and pistils.

The matured ovary, with the seed or seeds which it contains, is called the fruit. A stone-fruit with a fleshy covering, like the cherry, is called a drupe. A samara is a nut with a winged margin, like the key of the maple or the winged seed of the elm. A capsule is a dry fruit formed of a compound ovary and opening of itself, as the seed-vessel of kalmia, or shedding its seed through chinks, as in the poppy. A pome is an apple, or a fruit resembling an apple.

On most of the trees of temperate regions, the flowers are incomplete; wanting corolla or calyx or both, and having their place supplied by scales; and sometimes having the stamens and pistils in different flowers on the same, or even on different trees. They are often disposed in catkins or aments, which are the cylindrical, pendulous tassels which are seen, early in spring, on the birch and alder, for example; or clustered and

horizontal near the ends of the branches of the pine. In the plane-tree they are globular.

In my arrangement, I shall begin with those plants whose flowers are simplest or least complete, consisting of stamens only, or seed-vessels only; sustained and protected by one or two scales, and usually disposed in catkins; and proceed, in order, to those which have a calyx, but no corolla; those which have calyx and corolla; first of one petal; and lastly to those with a corolla of many petals with many stamens and pistils, — whose flowers are most complete.

An example will show the way in which the table may be used.

Suppose that a person has found a tree, with rough, simple, alternate leaves; flowers of two kinds, some with 5 stamens and no style, others with 5 stamens and 2 styles, with a calyx, but no corolla, and a fleshy, berry-like fruit, with a stone containing a single seed. He wishes to ascertain what the tree is. He begins with the first question, and, as the flowers are not in catkins, is referred to question 9. By that, as the leaves are alternate, he is referred to 20; thence, as the stamens are fewer than 10, to 21; thence, as the flowers are regular, to 22; as the flowers have not a corolla, but only a calyx resembling a corolla, he is referred to 23, and thence to 24; they have 2 styles, and he is referred to 28; 5 stamens, to 55, and he learns that his tree belongs to the elm family. The answer to question 55 shows him that it is the nettle-tree, and is described in the second section of the tenth family, which he will find indicated by X. 2.

DIVISION INTO FAMILIES.

1. { Flowers in catkins. 2.
   Flowers not in catkins. 9

2. { Leaves needle-shaped or scale-like, mostly evergreen. 43. Pine Family. I.
   Leaves not needle-shaped or scale-like. 3.

3. Sterile flowers only in catkins. 4.
Both sterile and fertile flowers in catkins. 5.

4. Leaves simple; nuts in a cup. 49. Oak Family. II.
Leaves pinnate; nuts not in a cup. 51. Walnut Family. IV.

5. Seeds with a tuft of cotton; fertile and sterile flowers on different plants. 54. Willow Family. VIII.
Seeds without a tuft. 6.

6. Leaves palmate; both fertile and sterile flowers in globular catkins. Plane Family. VII.
Leaves not palmate. 7.

7. Fruit woody, or membranous or winged. 52. Birch Family. V.
Fruit a dry berry or nut, not winged. 8.
Fruit a fleshy, compound berry. Mulberry Family. IX.

8. Nut more or less covered or concealed. 50. Hornbeam Family. III.
Nut naked. 53. Wax Myrtle Family. VI.

9. Leaves opposite. 10.
Leaves alternate. 20.
Leaves wanting. Cactus Family. XXV.

PLANTS WITH OPPOSITE LEAVES.

10. Flowers with a calyx, and a corolla of 1 petal, or with no corolla. 11.
Flowers with a calyx, distinct or obscure, and a corolla of many petals. 15.

11. Corolla wanting. 12.
Corolla of one petal. 13.

12. Leaves simple; fruit a double samara, or key. Maple Family. XXXIII.
Leaves pinnate; fruit a single samara, or key. Ash Family. XV. 2.

13. Stamens 4; calyx and corolla 4-parted; ovary 2 or 4 celled. 58. Madder Family. XVII.
Stamens 4 or 5; calyx and corolla 5-parted; ovary 3 or 5 celled. 14.

14. Corolla tubular, often irregular; style thread-like. 59. Honeysuckle Family. XX.
Corolla wheel-shaped, regular; style almost wanting. 61. Elder Family. XIX.

15. Stamens fewer than 10. 16.
Stamens more than 10; style one. 78. Rock-Rose Family. XXXVII.

16. Stamens more numerous than the petals. 17.
Stamens as many as the petals. 18.
Stamens once, or several times, 3; stigmas 3. 78.

17. Fruit a leathery, prickly capsule. Horse Chestnut Family. p. 479.
Fruit a double samara, or key. Maple Family. XXXIII.

18. Stamens opposite the petals; berry above the obsolete calyx. 76. Vine Family. XXX.
Stamens alternate with the petals. 19.

19. Calyx beneath 2 or three inflated capsules. BLADDER-NUT. XXXII. 1.
Calyx indistinct, surmounting a 2-celled drupe. CORNUS FAMILY. XXII.
Calyx evident; flowers in terminal panicles; berry fleshy. PRIM. XV. 1.

PLANTS WITH ALTERNATE LEAVES.

20. Stamens 10, or a smaller number. 21.
Stamens more than 10. 40.

21. Flowers irregular, butterfly-shaped; fruit in a pod. 75. BEAN FAMILY. XXIX.
Flowers regular or nearly so. 22.

22. Flowers with one petal, petals united at base, or with no corolla. 23.
Flowers with a corolla of many petals. 30.

23. Flowers with a calyx, but no corolla. 24.
Flowers with an evident calyx, and a corolla of one petal, or united petals. 35.

24. With 1 style or stigma: leaves simple. 25.
With 2 styles or stigmas, divergent; leaves simple. 28.
Pistils several; leaves compound. PRICKLY ASH FAMILY. XXXV.

25. Leaves with transparent dots; anthers opening by valves. 56. CINNAMON FAMILY. XII.
Leaves not dotted; anthers not opening by valves. 26.

26. Fruit one-seeded. 27.
Fruit 3 or more-seeded; a drupe or berry. 29.

27. Fruit crowned with a calyx. SANDAL-WOOD FAMILY. TUPELO. XI.
Fruit not crowned with a calyx. 28.

28. Stamens 5; a tree. 55. ELM FAMILY. X. 8.
Stamens 8; a shrub. MEZEREUM FAMILY. LEATHER-WOOD. XIII.

29. Leaves broad and flat; stamens 4 or 5. 77. BUCKTHORN FAMILY. XXXI.
Leaves broad and flat; stamens 6; fertile and sterile flowers on different plants. SMILAX FAMILY. XLI.
Leaves crowded, heath-like. CROWBERRY FAMILY. XIV.

30. Flowers with the calyx nearly obsolete. 31.
Flowers with an evident calyx. 32.

31. Fruit a drupe, crowned with the calyx; stamens alternate with the petals. CORNUS FAMIIY. XXII.
Fruit a berry, above the calyx; stamens opposite the petals. 76. VINE FAMILY. XXX.

32. Stamens as many as the distinct petals and alternate with them. 33.
Stamens as many as the distinct petals and opposite them. 38.
Stamens twice as many as the petals, 36.
Stamens 3, or several times 3. 37.

33. Calyx adherent to the ovary and crowning the many-seeded berry. CURRANT FAMILY. XXIV.
Calyx half adherent; capsule bony, 2-seeded. WITCH-HAZEL FAMILY. XXIII.
Calyx free from the ovary; fruit few-seeded. 34.
Calyx free; fruit many-seeded. 36.

34. Stamens on a fleshy disk; capsule berry-like. STAFF-TREE. XXXII. 2.
Stamens from the base of the calyx, or corolla, or from the receptacle. 37.

35. Anthers opening by pores. 36.
Anthers not opening by pores. 57 or 65.

36. Calyx free from the ovary. 62. HEATH FAMILY. XX.
Calyx adherent to the ovary. Berries eatable. 71. WHORTLEBERRY FAMILY. XXI.

37. Drupe berry-like, fleshy or pulpy, with 4—8 stones. 57. HOLLY FAMILY. XVI.
Drupe dry, 1-celled, 1-seeded. SUMACH FAMILY. XXXIV.
Capsule 3-celled, 1 or 2 seeded. 78.

38. Stamens 4—5; anthers not opening by valves. 39.
Stamens 6; anthers opening by valves. Prickly shrubs. BARBERRY FAMILY. XXXVII.

39. Tendril-bearing vines. Calyx obsolete. 76. THE VINE FAMILY. XXX.
Erect shrubs. Sepals united at base. 77. BUCKTHORN FAMILY. XXXI.

40. Stamens springing from the calyx. 41.
Stamens springing from the receptacle or base of the flower. 42.

41. Fruit neither a pome nor a drupe. 72. ROSE FAMILY. XXVI.
Fruit a pome; calyx persistent. 73. APPLE FAMILY. XXVII.
Fruit a drupe; calyx deciduous. 74. ALMOND FAMILY. XXVIII.

42. Pistil and style one; flowers perfect, stamens in parcels. LINDEN FAMILY. XXXVI.
Pistil and style one, flowers perfect, stamens not in parcels. 78. ROCK ROSE FAMILY. XXXVII.
Pistils about 2; only one ripening, forming a lunate drupe; sterile and fertile flowers on distinct plants. MOONSEED FAMILY. XXXIX.
Pistils many, united in a kind of cone; flowers perfect. 79. MAGNOLIA FAMILY. XL.

DIVISION INTO GENERA.

43. Leaves in bundles or tufts, in a sheath. 44.
Leaves solitary. 45.

44. Leaves 2—5 in a sheath, evergreen. PINE. I. 1.
Leaves 15—60 in a sheath, deciduous. LARCH. I. 4.

45. Leaves alternate. 46.
Leaves imbricate, opposite or in whorls. 48.

46. Fruit fleshy. YEW. I. 8.
Fruit not fleshy. 47.

47. Bark always rough. SPRUCE. I. 2.
Bark smooth on young trees. FIR. I. 3.

48. Leaves imbricate; branches fan-like; cones ovate. ARBOR VITÆ. I. 5.
Leaves imbricate; cones angular, somewhat spherical. WHITE-CEDAR. I. 6.
Leaves opposite, or in whorls; cones berry-like. RED-CEDAR and JUNIPER. I. 7.

49. Cup scaly or warty, not covering the acorn. OAK. II. 1.
Cup a prickly bur, covering the 3-cornered nut. BEECH. II. 2.
Cup a prickly bur, covering the roundish nut. CHESTNUT. II. 3.
Cup leathery, hairy, covering the nut. HAZEL. II. 4.

50. Nut in the axil or angle of a leaf-like bract. HORNBEAM. III. 1.
Nut enveloped in a hairy, inflated sack. HOP HORNBEAM. III. 2.

51. Husk not dividing naturally. WALNUT and BUTTERNUT. IV. 1.
Husk of the fruit dividing naturally. HICKORY. IV. 2.

52. Bark of thin, tough, horizontal fibres; aments simple; scale of the fertile catkins 3-flowered. BIRCH. V. 1.
Bark not of tough fibres; aments on branched stalks; scale of the fertile catkins 2-flowered. ALDER. V. 2.

53. Leaves lance-shaped, serrate. WAX MYRTLE and SWEET GALE. VI. 1.
Leaves sinuate-pinnatifid. SWEET FERN. VI. 2.

54. Stamens 8—30, or more; leaves 3-angled or roundish. POPLAR. VIII. 1.
Stamens 2—7; leaves mostly long, slender. WILLOW. VIII. 2.

55. Flowers perfect; fruit a samara. ELM. X. 1.
Flowers sterile, or perfect, on one or different trees; fruit a drupe. NETTLE-TREE. X. 2.

56. Anthers 4-celled; fruit-stalk fleshy; leaves often 3-lobed SASSAFRAS. XII. 1.
Anthers 2-celled; fruit-stalk not fleshy; leaves entire. BENZOIN. XII. 2.

57. Leaves thorny, leathery, evergreen. HOLLY. XVI. 1.
Leaves unarmed; petals 4—5, distinct; stamens 4—5. NEMOPANTHUS. XVI. 2.
Leaves unarmed; petals united, mostly 6-parted; stamens 4—6. WINTER BERRY, PRINOS. XVI. 3.

58. Flowers in globular heads. BUTTON-BUSH. XVII. 1.
Flowers 2 on each double ovary; berry of 2 united ovaries. PARTRIDGE BERRY, MITCHELLA. XVII. 2.

59. Stamens 4. Trailing, evergreen. TWIN FLOWER, LINNÆA. XVIII. 1.
Stamens 5. 60.

60. Stem not woody. Drupe 3-celled, 3-seeded. FEVERWORT. XVIII. 2.
Stem woody. Berry 2—3-celled, few-seeded; flowers two-fold, or in whorls. HONEYSUCKLE, LONICERA. XVIII. 3.
Stem woody. Berry 2-celled, many-seeded. BUSH HONEYSUCKLE, DIERVILLA. XVIII. 4.

61. Leaves pinnate. ELDER. XIX. 1.
Leaves simple. VIBURNUM. XIX. 2.

62. Petals united. 63.
Petals distinct or nearly so. 70.

63. Corolla somewhat funnel-shaped or bell-shaped. 64.
Corolla salver-shaped. 65.
Corolla ovoid. 66.

64. Stamens 5 or 6. AZALEA. XX. 9.
Stamens 10. RHODODENDRON. XX. 9.

65. Anthers resting in 10 cavities of the corolla. KALMIA. XX. 10.
Anthers free, calyx double. MAY-FLOWER, EPIGÆA. XX. 6.

66. Fruit a berry, formed of the fleshy calyx. CHECKERBERRY. XX. 7.
Fruit a drupe, formed of the ovary, 5-seeded. BEARBERRY. XX. 8.
Fruit a 5-celled, 5-valved capsule. 67. ANDROMEDA TRIBE. XX. 1.

67. Anthers ending in awns or bristles. 68.
Anthers not ending in awns. 69.

68. Anthers 2-awned. ANDROMEDA. XX. 1.
Anther-cells each 2-awned. ZENOBIA. XX. 4.

69. Calyx with 2 bracts at base. CASSANDRA. XX. 2.
Calyx without bracts at base. LYONIA. XX. 3.

70. Capsule 3-celled, 3-valved, enclosed by the calyx. Leaves smooth. CLETHRA. XX. 5.
Capsule 5-celled, 5-valved, opening at base. Leaves rusty-downy beneath. LEDUM. XX. 11.
Capsule 5-celled, 5-valved, opening at the summit; corolla irregular. RHODORA. XX. 9.

71. Corolla ovoid-bell-shaped. Berry sweetish, black or blue. WHORTLEBERRY. XXI. 1.
Corolla wheel-shaped, with reflexed segments. Berry acid, red. CRANBERRY. XXI. 2.
Corolla broad-bell-shaped. Berry pleasant, sub-acid, white. CHIOGENES. XXI. 3.

72. Fruit 3—5 distinct, dry follicles; unarmed. HARDHACK, SPIRÆA. XXVI. 1.
Fruit compound, of little drupes aggregated on a juicy receptacle; prickly. BRAMBLE, RUBUS. XXVI. 2.
Fruit the enlarged calyx, containing the stony seeds; prickly. ROSE, ROSA. XXVI. 3.

73. Petals roundish; branches thorny. HAWTHORN, CRATÆGUS. XXVII. 1.
Petals roundish; branches unarmed. PEAR, PYRUS, SORBUS. XXVII. 2.
Petals oblong; pome with 3—5 double cells. JUNE-BERRY, AMELANCHIER. XXVII. 3.

74. Stone compressed; fruit covered with a bloom. PLUM. XXVIII. 1.
Stone round; fruit not covered with bloom. CHERRY. XXVIII. 2.

75. Leaves pinnate; stamens united; flowers in pendent racemes; stipules thorny. LOCUST-TREE. XXIX. 1.
Leaves simple; stamens distinct. JUDAS-TREE. XXIX.

76. Leaves 3—5 lobed. Berry 1-celled. GRAPE-VINE. XXX. 1.
Leaves digitately 5-leaved. Berry 2-celled. VIRGINIA CREEPER. XXX. 2.

77. Calyx free from the ovary; petals plain; flowers minute; fruit like a drupe, black. BUCKTHORN. XXXI. 1.
Calyx adherent to the ovary at base; petals sack-like, arched; flowers in panicles; fruit a capsule. JERSEY TEA. XXXI. 2.

78. Petals 5, yellow; calyx 5-leaved, 2 outer smaller; plant erect. ROCK-ROSE, HELIANTHEMUM. XXXVII. 1.
Petals 3, brownish purple, sepals 3. PINWEED, LECHEA. XXXVII. 2.
Petals 5, yellow; calyx 3-parted, tubular, with 2 outer minute divisions; plant downy, tufted. HUDSONIA. XXXVII. 3.

79. Seeds pendulous by a thread, at maturity; leaves oval. MAGNOLIA. XL. 1
Seeds not pendulous; leaves truncate. TULIP-TREE. XL. 2.

FIRST GENERAL DIVISION.

DICOTYLEDONOUS PLANTS.

CHAPTER I. PLANTS WITH NAKED SEEDS.

FAMILY I. THE PINE FAMILY. — CONIFERÆ.

THE pines, firs, junipers, cypresses, spruces, larches, hemlock, and yews, with some foreign trees, form a very distinct and strikingly natural group. The name *evergreen*, by which they are commonly known, is liable to the exception that one of the genera found in our climate, the larch, loses its leaves in winter. But it is so distinguishing a characteristic of the rest, that it is likely to be long retained. This family has claims to our particular attention, from the importance of its products in naval, and especially in civil and domestic architecture, in many of the other arts, and, in some instances, in medicine. Some of the species, in this country, are of more rapid growth, attain to a larger size, and rise to a loftier height, than any other trees known. The white-pine is much the tallest of our native trees. Some are still found in New England reaching nearly to 200 feet; and it is not many years since pines were standing in the eastern part of New York, which measured 240 feet. Lambert's pine, on the Northwest coast, is found growing to the height of 230 feet;[1] and Doug-

[1] Mr. Douglas gives the following description of one: "One specimen, which had been blown down by the wind, — and this was certainly not the largest which I saw, — was of the following dimensions. Its entire length was 215 feet; its circumference, three feet from the ground, was 57 feet 9 inches; and at 134 feet from the ground, 17 feet 5 inches." — *Linnæan Transactions*, xvi. p. 500.

The resin of this pine is used by the natives of the North-west coast as sugar; and the seeds are eaten roasted, or are pounded into coarse cakes, as part of their winter store. — *Lambert's Genus Pinus*, p. 58.

las's pine, in the same region, the loftiest tree known, has been said to exceed 300 feet.[1]

From the pines are obtained the best masts, and much of the most valuable ship-timber; and, in the building and finishing of houses, they are of almost indispensable utility. The bark of some of them, as the hemlock and larch, is of great value in tanning; and from others are obtained the various kinds of pitch, tar, turpentine, resins, and balsams, so important in a commercial and economic point of view. Oil of turpentine, and Bordeaux and Strasburg turpentine, are obtained from different species of pine; Burgundy pitch, from the resin of the Norway spruce; Venetian turpentine, from the larch; Hungarian and Carpathian balsams, from pines; and Canadian balsam, from our native fir. Liquid storax, and the aromatic sandarach, are the products of oriental and African trees of the same family. Extracts of hemlock and spruce enter into the composition of spruce beer, as do juniper berries into that of gin, and to them it probably owes its valuable diuretic properties. The seeds of several of the larger pines are eatable.[2]

[1] This was written in 1842. Since that time, Sequoia gigantea (see our plate), much taller and larger, and several other trees of California, have been made known; and other trees, not evergreen, of the genus eucalyptus, have been described, found in Australia, taller still, but not so large.

[2] *Lindlay's Nat. Sys.*, 2d ed., p. 315. The juice of the pine is called liquid resin, or turpentine. Common turpentine is the resin of the Scotch fir, Pinus sylvestris, and is obtained by making incisions in the bark and wood. Yellow resin is obtained from this by boiling it down; and essential oil of turpentine, or spirits of turpentine, by distillation with water, the residuum from which operation is common resin, black resin, or colophony. These substances are extensively used in medicine, by painters, in paints and varnishes, and in various processes of the arts. Tar is obtained by slowly burning splintered pine, both trunk and root, without free access of air, and collecting the liquid in cavities beneath the burning pile. Pitch is common resin and tar melted together. Lamp-black is made by burning the impurities of tar and pitch, and collecting the soot. The inner bark of the Scotch fir is, by the natives of some Northern regions, collected in spring, dried and preserved, to be baked on coals, ground, and kneaded into bread. Hungarian balsam exudes from the branches of the Mugho pine, P. pumilio; and an essential oil, called Krumholz oil, is distilled therefrom. Carpathian balsam is distilled from the shoots of the Siberian stone-pine, P. Cembra. Strasburg turpentine is the liquid resin of the silver-fir, P. picea, collected from the vesicles in the bark; as is Canada balsam, or balsam of Gilead, from those in the bark of our balsam-fir, Picea balsamea. Concrete resin exudes from the Norway spruce; Burgundy pitch is prepared, by boiling, from the resinous juice of the same tree, flowing from incisions in the bark.

There is also another circumstance in their history, of great interest to a country so large portions of which are spread over with sterile siliceous sands. On these, which are almost barren of other products, several species of pines may be planted, or are found growing naturally with an approach to luxuriance. They will even take root and flourish, with proper care, among the moving sands exposed to the sea-breezes, thereby fixing these sands, and redeeming to the use of man tracts otherwise destined to perpetual sterility.

The root of the pines is generally woody and irregularly ramified, and remarkable for its toughness and durability.[1] It never descends to a great depth, but spreads horizontally, to no great distance, near the surface. It is short and small, in comparison to the size of the tree, in this respect resembling that of the palms. In consequence of this peculiarity, most of the pines are uprooted by high winds, while the deciduous trees are broken off near the ground. In the winter of 1839–40, I had an opportunity of examining the roots of a very large number of various species of pine which had been uprooted by the violent gale of the previous November, and I found that, in every case, they spread to a very inconsiderable distance, just below the surface of the ground. In old trees, of several species, particularly the white-pine, the swollen roots appear above the ground to some distance from the trunk. In no instance, except in the anomalous case of the Southern cypress,[2] are suckers thrown up from the root; and only in the pitch-pine have shoots been observed to spring from the stump.

[1] L. C. Richard, *Commentatio Botanica de Coniferis et Cycadeis*, p. 89 *et seq.*

[2] There is a striking peculiarity in the roots of the Cupressus disticha (Taxodium) of our Southern States. This tree grows naturally in low grounds subject to annual inundations, in which situation it rises sometimes to the height of 120 feet, with a diameter at base of 25, 30, or even 40 feet. The roots, which run horizontally at a short depth below the surface, throw up conical, rounded protuberances, sometimes 4 or 5 feet high, but usually much smaller, smooth without and hollow, looking not unlike mile-posts, and remaining always naked. These may be observed, on a small scale, about the base of the magnificent cypress in Bartram's Garden, near Philadelphia.

Most of the plants of this family are trees of an erect, straight, cylindrical trunk, often of great size and height. In some, as the hemlock, the yew, and the gingko-tree, the branches have no regular order; but in most, and especially in the firs and pines, they are disposed circularly, in imperfect whorls, around the trunk. One of these whorls is formed each year, from the row of buds which encircle that of the leading shoot, thus furnishing an easy mode of ascertaining the age of young trees. Where they grow together in thick woods, as occurs everywhere in our primeval forests, the lower whorls of branches speedily decay, from the absence of light and air, leaving a smooth trunk, rising with a beautiful shaft and scarcely perceptible taper, without a branch, to the height of 60, or even 100 or more feet. In the same manner grow the spruces and firs; and so the white-pines in Maine still grow. Most of these forests, of the larger trees, have disappeared from Massachusetts, though a few are still to be found. In the cedar swamps, the straight stems are often found so near together, that such swamps can with great difficulty be penetrated.

The disposition and direction of the branches present striking differences in the different species, giving them each a peculiarity of aspect by which they can easily be distinguished at a distance. The regular horizontal stages of the white-pine, the round, tufted masses of the pitch-pine, the fan-like branches of the arbor vitæ, the formal pyramid of the spruce, the graceful cone of the fir, the fantastic and often irregular raggedness of the red-cedar, the spiry grace of the white-cedar, and the softness and delicate outline of the hemlock, must have struck every observer. When growing naturally in the forest, the branches are always small; but when a tree stands by itself, the branches often grow large, and are numerous and permanent; and when the leading shoot is destroyed, the upper branches, particularly in the white and pitch-pines, attain a great size. The bark of these trees, while young, is

thin, and in most cases smooth. In the pitch and red pines, and in the spruce, it is always rough. On the fir, it remains always thin and comparatively smooth, and full of cavities or crypts containing the balsam. In most of the true pines, it becomes, on old trees, very thick, rugged, and deeply cleft. In the hemlock and larch, and in some of the pines, it is charged with tannin.

The wood is disposed in concentric circular layers. The fibres are parallel and not closely arranged, but have considerable strength and elasticity. The wood differs physiologically from that of other trees, in being made up entirely of woody fibres, which are hollow tubes marked externally with rows of microscopic, circular disks. The resin is deposited in peculiar vessels which have received the name of *turpentine vessels*. From the great abundance of resin which it contains, the wood is very combustible and remarkable for its durability. In the wood of most of the pines, the resin does not seem to be deposited, at least in great quantities, during the life of the part. Old trunks are often found consisting almost entirely of *heart-wood*, soft, and of a reddish or yellowish color, almost free from resin throughout. Where a growing branch is broken off, the remaining portion becomes charged with resin, forming what is called a *pitch-knot*, extending sometimes to the heart. The same thing takes place through the whole heart of a tree, when, full of juices, its life is suddenly destroyed; and it is commonly supposed that the heart-wood of the trunk of a pitch-pine increases in weight after it has fallen to the ground.

The leaves of the pines are very various. Most of the species have persistent leaves, and naturally come under the denomination of evergreen; but some of them, as the larch and gingko-tree, for example, lose their leaves at the approach of winter. In the yew, and some others, they are scattered irregularly; in some, as the arbor vitæ, they are opposite; in others, as the juniper, they are in whorls; and in the true

pines they are in bundles, or fascicles, contained in a sheath formed of an altered leaf. The bundles in the true pines, and the solitary leaves in several of the most nearly allied genera, are arranged in spiral lines, which, to the number of five, six, or more, run parallel to each other around the tree. The same arrangement is found in the scales of the cones. The bundles are considered by the botanist as extremely short, abortive branches, as is often obvious in the larch. If we examine a pine of the first or second season, which may be readily done in our pine forests, we find the leaves single. Afterwards, from the axil of the solitary leaves, bundles of leaves, or abortive branches, make their appearance, and finally the leaves are protected at base by a sheath.

The shape of the leaves is singularly various. For the most part they are linear, needle-like, or awl-shaped and stiff, as in the true pines, in which they vary, in different species, from two or three to twelve and even eighteen inches in length, in bundles of from two to six in a bundle. In the firs and spruces they are shorter, and flat or prismatic ; still more so in the juniper and the yew ; and in the cedar, sequoia, and cypress they are reduced to little more than pointed scales.[1] All of this family may be considered as destitute of stipules ; the apparent stipules sometimes seen on the shoots from the stump of the pitch-pine, being in reality solitary leaves, with bundles of leaves springing from their axils.

The buds exhibit a great variety of structure. Often they are naked, as in the juniper and arbor vitæ, the apparent scales taking, as they expand, the form of true leaves. Sometimes, as in the several species of pine, they are covered by scales totally different from leaves. They are sometimes, as in the fir, enveloped by resin ; sometimes, free from it. They usually,

[1] In some of the foreign genera, they are broader and lanceolate, as in podocarpus ; whilst in a few, as the agathis and gingko, they expand into a resemblance to the leaves of other dicotyledonous vegetables. In the remote genera callitris and ephedra, they are so small, scale-like, and distant, as to give the plant the appearance of being destitute of leaves.

as in the pines, proceed only from the extremity of the trunk or branches, and contain the annual addition to the stem, and the whorl of branches.

With very few exceptions, the pines are monœcious, the male and female flowers being in different parts of the same plant, both usually disposed in cones or catkins, but totally unlike in structure. The male flowers consist of one or more stamens usually attached, with or without a stalk, to a scale, which, however, is sometimes wanting. The catkins of the male flowers are far more numerous than the cones of the female flowers. The yellow pollen, which is very abundant, often falls in such quantities upon the branches and leaves below, and upon the neighboring plants, as to cover them; and, being as light and fine as dust, it has been sometimes carried by the wind from a forest of pines, and spread upon the ground at a distance. This affords a probable explanation of the stories which have been told, and which have been regarded with superstition or incredulity, of showers of sulphur.[1]

The female flower has till recently been considered as a pistil enclosed by a calyx and accompanied by one or more scales. Robert Brown has satisfactorily shown that, in all plants of this natural family, there is neither pistil nor stigma, but that what have been considered such are merely the extremities of a tube leading to a naked ovule, which is fertilized by the direct contact of the pollen from the male flower. In several of the genera the female flowers are single, and terminal or axillary. In most others they are arranged in cones. They are extremely simple, consisting usually of two scales, one which hardens and enlarges and forms a part of the surface of the cone, and a thinner one within it.

[1] Poiret, *Botanique, Dictionnaire Méthodique,* V., 331. Lambert, describing the common Scotch fir, says: "The pollen is sometimes in spring carried away by the wind in such quantities as to alarm the ignorant with the notion of its raining brimstone." — *Genus Pinus,* p. 2.

The ovary, with the calyx scale to which it more or less adheres, becomes the fruit. These have a great variety of appearance, from the fleshy, berry-like fruit of the yew and juniper, to the winged scale of the pine; but, when carefully examined, in their earlier stages, they are seen to have a strong mutual resemblance; the fruit of the yew being formed by an extraordinary development of the receptacle, which, in most of the other genera, experiences little change, in the true pines a portion only of calyx expanding into a membranous wing.

The cones of many of the pines require two or three years to come to perfection. That of Pinus pinea, the stone-pine of Europe, with edible seeds, requires three or four. During the first season the cone attains one-third part of its size; in the second it reaches its full size, but remains green; in the third the scales usually become dry, change color, and open, and the winged seed escapes, and is carried to a distance by the winds.

The seeds of many of the pines are large and eatable. Those of our forests are small, but they are eagerly eaten by such birds as have the means of separating them from their cones, such as the pine cross-bill; and they furnish a portion of the winter's store to the red squirrel, and other small quadrupeds which do not hibernate. These seeds consist of farinaceous matter impregnated with resin and oil. They are thence very nutritious. In some instances they may be eaten without preparation, as is the case with those of the stone-pine of the South of Europe, in several countries of which they form a not unimportant article of food, and with those of the Araucarian pine[1] of South America. In other cases the acridity of the oil must be previously removed by roasting.

[1] The Indians make use of the fruit of this tree, the Araucaria imbricata, as a very nourishing food. They eat it raw, as well as boiled and roasted; with it they form pastry, and distil from it a spirituous liquor. There are stated times to collect the fruit, which they preserve to make use of as required. — *Lambert's Genus Pinus*, p. 108.

The seeds of the Brazil pine, Araucaria Braziliana, are sold as an article of food in the streets of Rio de Janeiro. — Ibid. 111.

The tenacity of life of the seeds is remarkable. They will remain for many years unchanged in the ground, protected by the coolness and deep shade of the forest above them. But when the forest is removed, and the warmth of the sun admitted, they immediately vegetate. When the first leaves make their appearance above the surface, some of them, as those of the true pine and of others of that section, exhibit several seed-leaves, showing that their seeds are apparently provided with several cotyledons. They thus form an exception to the nearly universal character of the division of plants to which they belong. Some physiologists consider the exception only apparent, and regard the cotyledons as two, very deeply lobed.

The most remarkable tree of the pine family, the largest and loftiest of trees, is the Sequoia gigantea,[1] the giant of the pines. Professor Brewer saw trees of this scattered through the forests in great numbers on the western flanks of the Sierra Nevada. He says: "The largest tree I saw was 106 feet in circumference, at 4 feet from the ground. It had lost some buttresses by fire; it must have been at least 115 or 120 feet when entire; it is 276 feet high. The Indians tell of a much higher tree. One has been seen lately which measured 112 feet in girth, but had been broken off at the height of 300 feet, where it measured 18 feet in diameter; and it was conjectured that, when entire, it could not have been less than 450 feet high. There seems to be no danger of the speedy extinction of the species, as it is now known in quite a number of localities; and there are immense numbers of younger trees of all sizes, from the seedling to the largest."

The redwood, Sequoia sempervivens, is also a magnificent tree, and of the greatest value. Douglas says he repeatedly measured specimens 270 feet long and 32 feet in circumference, at three feet from the ground.[2]

[1] Named in honor of the Cherokee chief who invented an original alphabet, and spent his life in endeavoring to enlighten and elevate his race.

[2] *Josiah Hoopes's Book of Evergreens*, p. 243.

GIANT OF THE PINES. *Sequoia gigantea.*

Insects on the Pines. — With the exception of the oaks, the pines furnish sustenance to a greater number of insects than any other family of trees. The several parts of the tree — the leaves, the bark, the shoots, and the trunk — have each their peculiar inhabitants and enemies; terms which, in this case, are synonymous.

The leaves of the pines feed the "curiously checkered caterpillar of the *Sphinx coniferarum;*" those of the pitch-pine, and, more especially, of the fir, are destroyed by swarms of the false caterpillars of the *Lophyrus abietis.*[1]

Several species of weevil, of which two (the Pales weevil, *Curculio pales*, and the white-pine weevil, *Rhynchœnus strobi*)[2] are particularly described by Dr. Harris, dwell, during their larva state, under the bark of the pitch-pine, the white-pine, and probably others, and often do immense injury by destroying the alburnum, and the inner portion of the bark. Whole forests of pines are sometimes thus killed by these apparently insignificant creatures. In addition to this mode of assault, the weevil, which receives its name from the white-pine, does great mischief by piercing, with holes from the interior of the wood to the bark, the leading shoot of this tree; thus destroying the shoot and maiming and deforming the tree. These attacks would soon be fatal to the whole race of white-pines, and probably all the others of the genus, were it not for an ichneumon-fly which deposits its eggs in the larva of the weevils, and the effectual services of the woodpeckers, who spend their useful lives in destroying them. The terminal buds and leading shoots of the pines and firs are often destroyed by turpentine moths, — an entirely different enemy, associated with the leaf-rollers.[3]

A small brown, cylindrical beetle, the boring hylurgus (*Hylurgus terebrans*),[4] deposits its eggs in the bark of the pitch and other pines, the soft inner layers of which the grubs de-

[1] *Harris's Report*, pp. 328–520.
[2] Ibid. pp. 72, 73.
[3] *Tortrices*, Ibid. p. 484.
[4] Ibid. p. 86.

vour, and, by preventing the formation of new wood, and by loosening the bark, cause the trees to languish and decay. They are sometimes accompanied by the grub of a smaller bark-beetle (the *Tomicus exesus*),[1] which leads a similar life, with similar consequences. Another still smaller beetle, of the same pernicious family and habits (the *Tomicus pini* of Mr. Say),[2] has been found under the bark of the white and pitch pines, and that of the larch. The red-cedar has a very small bark-beetle (*Hylurgus dentatus*, the toothed hylurgus).[3] A still more conspicuous bark-loosener, the ribbed Rhagium (*Rhaghium lineatum*),[4] which does a work hardly less fatal for that tree, is found, in the grub state, often in great numbers, under the bark of the pitch-pine.

But the most numerous, if not the most fatal, of the enemies of the pines, are the various kinds of borer which infest the trunk, on the wood of which they subsist. Two species of *Urocerus*, or horn-tail, neither of them common (the *albicornis* and *abdominalis*),[5] are found on the pines. They bore long holes in the trunk. The grubs of the one-colored Prionus (*Prionus unicolor*),[6] a large beetle, are also found in the same trees. Several beetles of the genus *Callidium* live, while in the grub state, in the trunks of pines and firs, or in the timber of these trees. One of them (*Callidium bajulus*),[7] which is found in "fir, spruce, and hemlock wood and lumber," is supposed to have been introduced from Europe. Of the Buprestian beetles, the larvæ of which are wood-borers and eaters, and several of which are particularly fond of pines, the largest is the Virginian (*Buprestis Virginica*),[8] which commits great ravages by boring in the trunks of the various kinds of pine trees. A much smaller species (*Buprestis fulvoguttata*, the tawny-spotted)[9] has been taken from the trunk of the white-pine. Young saplings, and small limbs of the same species of

[1] *Harris's Report*, p. 87. [2] Ibid. p. 88. [3] Ibid. p. 87.
[4] Ibid. p. 116. [5] Ibid. pp. 538–540. [6] Ibid. p. 96.
[7] Ibid. p. 100. [8] Ibid. p. 48. [9] Ibid. p. 50.

tree, are inhabited by a beetle of nearly the same size with the last-mentioned, to which has been given, by Professor Hentz, the name of Dr. Harris's Buprestis (*Buprestis Harrisii*).[1]

The soil natural to most of the pines is a sand formed originally by the crumbling or disintegration of the granitic rocks. These, in the forms of gneiss, mica slate, and granite, are the prevailing rocks of Massachusetts; large portions of which, moreover, are overspread by the diluvium of sand formed from them. A large part of the surface was, therefore, and in many places still is, covered with forests of pine. The different species are adapted to the opposite extremities of moisture and dryness. The pitch-pine flourishes on arid and parched sands; the white-cedar thrives in swamps which are inundated almost through the year; the white-pine prefers a situation moderately dry, but is often found in swamps; the red-cedar and larch are found on rocky hills nearly destitute of soil; and the spruce and hemlock grow naturally in places inclined to moisture.

The pines are most readily propagated by seed. In and near the pine forests, they are sown naturally by the opening of the cones when mature, and the dispersion of the winged seeds by the wind. As the seeds of most species are very light, they are often carried to a considerable distance, and their abundance is such that a single tree is sufficient to furnish seed for many acres. A few pines, scattered through a forest of deciduous trees, fill the ground with seed, in a series of years, so completely that, when the forest is cut down, it not unfrequently happens that a pine forest springs up in its place.

If the trees are to be propagated artificially, the seed must be deposited on or near the surface: it should not be buried beneath; or, in case this is absolutely necessary, as when they

[1] *Harris's Report*, p. 51.

are sown in open fields, the covering should not exceed an eighth of an inch, and should be light and loose. A soil and surface formed by the decay of the leaves of deciduous trees, is best, as it is precisely that in which the seed naturally vegetates. There are now, in every part of Massachusetts, large tracts of land which are too sterile, or too rough and rocky, to be cultivated to advantage, which might be easily sown with the different species of pine adapted to the various soils. The pitch-pine would cover the sands; the red-cedar and larch, the rocky hills; the white-cedar, the swamps; and the hemlock and spruce, the white-pine and the Scotch pine, all the regions between. Such tracts are often overrun with low bushes, amongst which the seeds might be cast, and which would afford protection to the young plants against the winds and the heat of the sun.

All the pines require to be cultivated in large masses. They naturally grow thus; and although, when so growing, they seem to be extremely hardy, they do not thrive when solitary, but are parched by the sun, and stunted by the cold and wind.[1] In masses, especially when large enough to cover several acres, they not only protect each other, but are the best possible nurses for the tender deciduous trees. For this purpose, the Scotch pine is extensively employed in all young plantations in England and France, where the cultivation of forest-trees has received the greatest attention.

The cones, which are mature after one, two, or three seasons, may be gathered in the winter, as the scales do not usually open, to allow the seeds to escape, until the spring. Most of them, when perfectly dry, open spontaneously, and allow the seeds to be shaken out. In others they must be released by exposure to the sun, or by force, either by cutting open the cone with a sharp instrument, or by beating, or by

[1] The pitch-pine, usually considered the hardiest, is much more affected by the sun and the wind than the Scotch pine, Pinus sylvestris, planted in the same situation.

crushing in a bark-mill. Two winged seeds are usually found above each scale.

The best time for sowing the seeds is early in spring, as soon as the frost is out of the ground. If sown in autumn, they are liable to be devoured by mice and squirrels. If a few trees are to be provided for ornament or shade, the seeds may be sown in a prepared seed-bed of pulverized earth, and loosely covered to the depth of one-eighth, or at most one-fourth, of an inch. The bed should be in a sheltered situation, and the surface should be protected, from the action of the wind and sun, by loose branches, straw, or leaves. The soil of the seed-bed should be loamy or sandy, and, as in the case of the seed-beds of most other trees, it should be rich, as the thrift of the future tree depends much upon the vigor of the first shoot. The practice in France is to sow them in somewhat rich bog earth, or a mixture of this with sand. The seeds should be sown in rows, for the convenience of keeping the plants free from weeds. They have been observed to come up in from thirty to fifty days, but, in some instances, do not make their appearance until the succeeding spring, or even later. After they have grown two years in the seed-bed, they may be transplanted to a sheltered and fertile nursery, where they should remain at least one year, before being removed to the spot where they are to stand.

Such is the course to be pursued when it is an object to have fine trees in the shortest time. But when poor, thin, rocky or sandy land is to be clothed with wood, and it is important to save the time and expense of the several transplantations, the seeds may be sown where the trees are intended to remain. They must be sown abundantly, as they are obnoxious to destruction by various enemies. On a rocky surface, they may be cast into the crevices of the rocks, or beneath the thin soil which covers them. On an open plain, they require protection; which may be found in various low bushes, such as sweet fern; or if sown on a waste, sterile land, they must be

sown with the seeds of some quick-growing shrub, or tall grass, which shall protect them for two or three years. For the first two or three years, these plants are of slow growth; but, after the fifth, they grow very rapidly; and continue, in favorable situations, to make one or two feet annually, until they have reached twenty or thirty feet, and, in the case of the taller species, a much greater height. The root, in most species, penetrates at once, in the first or second year, to the depth of one or two feet, but never to a much greater depth.

The evergreens are transplanted with less facility and success than most deciduous trees. Those intended for transplantation are, therefore, in the English nurseries, usually kept in pots, whereby they are prevented from throwing down a long root. All the pines are, however, successfully transplanted, if sufficient care be taken not to injure the roots nor heads, and to have a pit sufficiently large for all the roots to be fully spread, and *not to set them too deep.* The most difficult are the white and pitch pines. To ensure success, these should be transplanted in winter; the pits having been formed, and the plant to be moved having been surrounded by a circular trench, in the previous autumn. In this way, the whole of the roots, with the frozen earth adhering, may be removed in a single ball, and set at once in the pit, and surrounded by loose earth kept ready for the purpose.

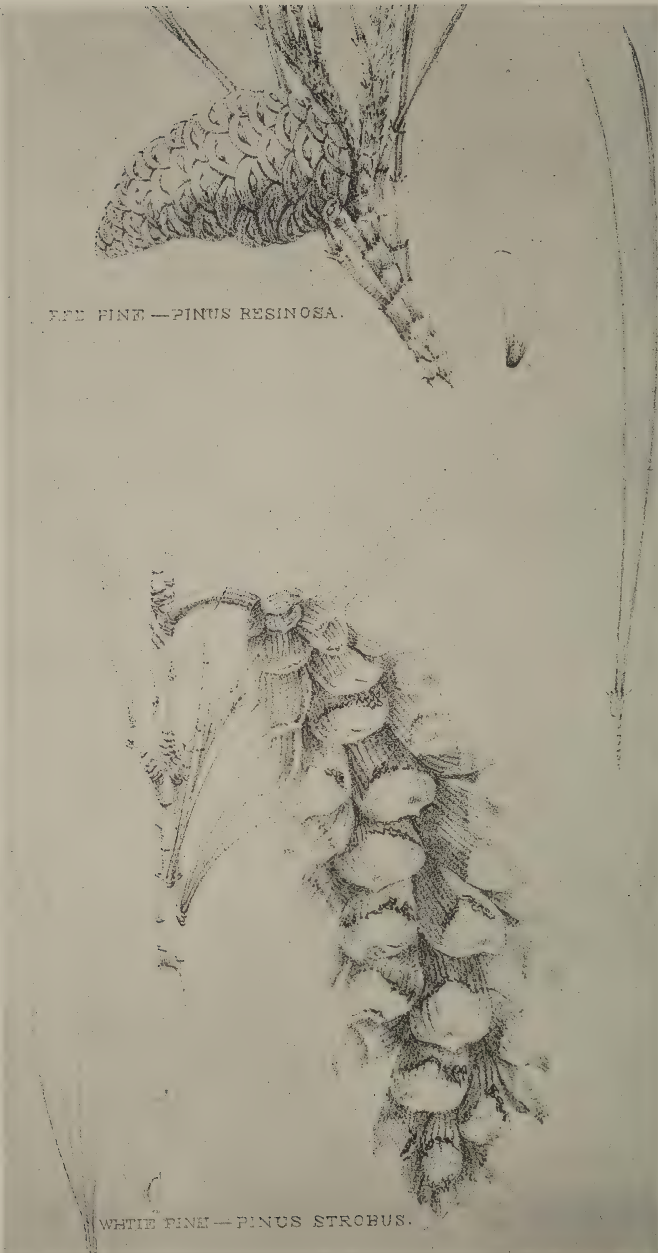
The evergreens have been divided [1] into three sections:—

1. Those whose fruit is a true cone, with numerous imbricate scales, like the fir and pine.

2. Those with a globular, compound fruit, like the cypress and arbor vitæ.

3. Those with a solitary fruit, like the yew.

[1] By L. C. Richard, *Annales du Museum*, XVI., 296.



RED PINE—PINUS RESINOSA.

WHTIE PINE—PINUS STROBUS.

SECTION FIRST.

THE PINE AND FIR TRIBE. *ABIETINÆ.* Richard.

Of this section there are found growing in Massachusetts, — 1. The White-Pine; 2. The Red or Norway Pine; 3. The Pitch-Pine; 4. The Hemlock-Spruce; 5. The Black or Double Spruce; 6. The White, or single Spruce; 7. The Balsam-Fir; 8. The double-Balsam Fir, or Frazer's Fir; and 9. The American Larch, or Hacmatack.

I. 1. The Pine. *Pinus.* L.

The true pines are characterized by having their leaves in a sheath, 2, 3, or 5 together; and by the large size and hardness of the cones. Alphonse De Candolle, in the "Prodromus," part 16th, enumerates, in 1864, 281 species and many varieties, of which species fifty-one are American. Fifty-five species are described as having been introduced into England. They are all evergreen, generally of large size, and eminently useful and ornamental. Twenty-seven [1] are natives of North America, of which three are found in Massachusetts, distinguished by the number of leaves in a sheath: these are either 5, on the white-pine; 3, on the pitch-pine; or 2, on the red-pine.

I. Sp. 1. The White-Pine. *Pinus Strobus.* L.

Figured in Lambert's Pinus; Plate 32.
Michaux; Sylva, III., Plate 145.
Loudon; Arboretum, VIII., Plate 329.
Our Figure.

This tree is easily distinguished by its leaves being in fives; by its very long cones, composed of loosely arranged scales;

[1] Lambertiana, strobus, monticola, leiophylla, Montezumæ, radiata, tuberculata, muricata, Californiana, Llaveana, patula, teocote, australis, Coulteri, Sabiniana, ponderosa, serotina, rigida, tæda, resinosa, pungens, mitis, inops, Banksiana, insignis, contorta, turbinata.

and, when young, by the smoothness and delicate light green color of the bark. It is known throughout New England by the name of white-pine, which is given it on account of the whiteness of the wood. In England, it is called the Weymouth pine.

The white-pine is the tallest and most stately tree of our forests. It rises in a single straight column, tapering gradually, often to the height of 100, and sometimes, in the western part of the State, to that of 130 or 140 feet. In the forest, they are found with a shaft of 100 feet, of arrowy straightness, entirely free from limbs. Formerly they were seen much taller; for the largest and most valuable timber trees have long since been cut down. Dr. Dwight informs us[1] that they were frequently 250 feet in height and 6 feet in diameter; and he mentions one in Lancaster, N. H., which measured 264 feet. Fifty years ago, several trees growing on rather dry land in Blandford, measured, after they were felled, more than thirteen rods and a half, — or 223 feet. Many large trees are still found on the Penobscot and its branches. In the summer of 1841, a mast was made on that river, which measured, after being hewn to an octagonal shape, 90 feet in length, 36 inches in diameter at the butt, and 28 inches at the top. Many masts are annually hewn on that river, from 70 to 90 feet in length. There is so much grandeur in these magnificent columns, that it is surprising that so few have been left. There would be little danger of their being prostrated by the wind, if left standing when the forest is cut away about them, as their leafy branches usually stand out, far above the tops of the trees by which they are surrounded, and they are thus accustomed to bear the violence of the storms. A clump of old white-pines stands in perfect security, near the church in Blandford, on one of the most exposed points of the Green Mountain range. It is not uncommon to see old pines standing, deformed by the loss of the leading shoot, — a loss from

[1] *Travels*, Vol. I., p. 36.

which they never recover, unless it occurs when the tree is quite young. Rarely two or more leaders are seen going up together.[1]

The roots of the white-pine, even in the old trees of 70 or 100 feet in height, rarely penetrate more than two or three feet, taper rapidly, and extend 12 or 15, not often 20 feet, on every side. In trees of not over 25 or 30 feet, the roots do not penetrate more than 15 or 18 inches. They are covered with a reddish or grayish, sulphur-colored bark, broken on the surface into irregular rectangular scales. The wand-like rootlets, which are few in number, are very pliant and tough. The roots in old trees swell and project above the surface, forming natural buttresses on every side, for the support of the trunk. The bark on trees less than fifteen inches in diameter is very smooth, of a reddish bottle-green, covered, in summer, with an ashy or pearly gloss. On old trunks, it is less rough than that of any other pine. It is cleft by superficial vertical clefts into long plates, two or three inches wide, which become more rough on the older trees, but do not scale off. The branches are in whorls or regular stages of about five at each stage, tending slightly upwards when young, but in old trees horizontal. In the forests all but the upper branches decay and disappear, and these, stretching out over the tops of the other trees, are conspicuous, and help to distinguish the white-pines as far as they can be seen. The smaller branches are marked with spiral lines of the cicatrices of the fallen leaves. A single large bud, encircled by about five smaller ones, terminates each branch. The leaves are in fives, of a soft bluish green, slender, and from three to five inches long, arranged spirally in long tufts at the ends of all the branches, and giving great beauty to the young trees.

[1] An old pine in the depth of a forest is often interesting from the variety of vegetable life which it exhibits, — covered with lichens, dotted Lecideas and Lecanoras and Verrucarias closely investing the bark on the lower part of the trunk, star-like Parmelias spreading over them, green and purple mosses in the crannies, and tufts of Sticta, Ramalina, and Usnea higher up.

On the extremity of the newly opened buds, on the ends of the uppermost branches, are found the fertile flowers in erect cones, which, in June, at the time of the maturity of the staminate cone, are 3-10ths of an inch long, and half as broad, on scaly footstalks, 7-10ths of an inch long. These cones are made up of small, broad, fleshy scales, imbricately arranged in spirals. Outside the base of each is a thin, membranous, ragged scale, and within, near the base, two oblique openings, marked by a slight projection. These lead to cavities containing the ovule or future seed. There are neither styles nor stigmas, and the naked ovule is supposed to be fecundated by the fertilizing pollen coming directly in contact with it. At the end of one season, the cones are two or three inches long, of a fresh green, reflexed, on stout footstalks. In the succeeding autumn they are mature, when they are from four to six inches long.

The male flowers are in brown cones, 3-8ths of an inch long by 1-8th broad, on short stalks, surrounded by scales, occupying, to the number of twenty or more, half an inch of the base of some of the new shoots on the extremities of the lower branches. The pollen is contained in numerous, anther-like, double sacks, opening on each side from top to bottom.

The geographical range of the white-pine is from the Saskatchewan, in about 54° north, to Georgia, where it is found only on the ridges of the Alleghany Mountains; and from Nova Scotia to the Rocky Mountains; and beyond, from the sources of the Columbia to Mount Hood. It occurs in every part of New England; growing in every variety of soil, but flourishing best in a deep, moist soil of loamy sand.

The white-pines receive different names, according to their mode of growth and the appearance of the wood. When growing densely in deep and damp old forests, with only a few branches near the top, the slowly-grown wood is perfectly clear and soft, destitute of resin, and almost without sap-wood, and has a yellowish color, like the flesh of the pumpkin. It is then called pumpkin pine. Standing nearly by itself, or surrounded

MONSTER PINES. *Pinus strobus.*

WEST PARK, PHILADELPHIA.

by deciduous trees, especially on the boundaries between high lands and swamps, it grows rapidly, is usually full of knots and resin, has much sap-wood, and thence receives the name of sapling pine. Bull sapling resembles the pumpkin pine in all respects save the color of the wood, which is a clear white. These names are little used, except in Maine and by persons who import wood from that State.

The roots of the white-pine are almost incorruptible. In clearing up new lands, where the trees have been felled or blown down, the stumps with the roots are often taken up and used to make a fence by setting the under surface of the roots, to form the outside, towards the road. Fences so made exhibit, after a hundred years, few signs of decay.

The branches, taken from the tree when they are beginning to die, form somewhat durable stakes; while the trunks of small trees used in this way decay very rapidly.

The qualities of the wood are lightness, softness, and durability. Its specific gravity, according to Mr. Bull, is .418, being less than that of any tree except the Lombardy poplar. It is wrought with perfect ease, cutting freely in every direction. When kept dry, or exposed to the air, above the influence of the ground, it lasts for a great number of years; and is not split or much shrunk or warped by the sun; but it is subject to rapid decay when placed near the ground. Its defect is its want of strength.

The uses of the wood of the white-pine are most important and numerous. As it forms timber and boards of a greater size than any other soft-wooded tree, and is lighter and more free from knots, it is employed, in preference, for masts of ships, for the large beams, posts, and covering of wooden buildings, and for the framework of houses, barns, and bridges, as well as for clapboards, and sometimes for shingles. The clear ness, softness, and beauty, of this wood recommend it for the panels and frames of doors, for wainscoting, for the frames of windows, for cornices and mouldings, and for all the uses of

the joiner. As it receives paint perfectly, it is employed for floors which are to be painted. For such as are exposed to much wear, as those of kitchens and back entries and stairs, the woods of the pitch-pine and southern pine are preferred, on account of their superior hardness.

Every thing made of white-pine is usually painted; but doors, panels, and tables of this wood are sometimes only varnished, so as to exhibit the wood itself. In this state, it gradually takes a yellowish or light reddish color, and becomes very beautiful. Stained and varnished, it is a beautiful material for wainscoting, window-frames, and the other internal finishing of a house.

It is excellent for the carver in wood, and is used for the figure-heads of vessels; and, as it takes gilding well, it is preferred for the frames of looking-glasses and pictures. In all the ways in which it can be used as fuel, it is of little value, though it burns freely when dry, and is much used for kindling.

In consequence of these numerous uses, it is every year becoming more scarce. The exportation from the growth of this State has almost ceased, and from New Hampshire and the southern parts of Maine it has much diminished, and the lumber has become of inferior quality. From the Penobscot and other great rivers in the northern parts of that State, the exportation is still immense; but the lumberers have to go every year to a greater distance from the great water-courses, and to ascend smaller streams and more remote lakes. The same thing is happening in New York; and the day is evidently not far distant, when the inhabitants of New England even, will have to depend on Canada for this wood, unless measures are taken to restore the pine forests on those millions of acres which are suitable for no other use, while they are admirably adapted to the production of various kinds of pine.

The white-pine is a tree of rapid growth. Where it has been cultivated, in England and France, it has been found to increase in height at the rate of from 15 inches to 3 feet, each

year, for fifty or sixty years. A tree near Paris, thirty years planted, is 80 feet high, with a diameter of 3 feet. By observing the annual stages of limbs, it may be seen, that in many parts of this State, it grows in height 3 or 4 feet a year, and sometimes more. In Dalton, I measured an old white-pine, which was more than 100 feet high, and found its circumference at the ground 12 feet 8 inches, and, at 3 feet, 10 feet 9 inches.

In 1809 or 1810 a belt of pines and other trees was planted on two sides of the Botanic Garden, in Cambridge, to protect it from the north-west winds. In the winter of 1841 and 1842, when they had been growing thirty-one years, many of them were carefully measured by myself, with the assistance of the skilful and intelligent gardener, Mr. Carter. Ten of the white-pines exhibited an average of 20 inches diameter at the ground, showing an annual growth of nearly two-thirds of an inch in diameter. The two largest measured 5 feet 7 inches in circumference at the ground, and 4 feet 8 inches at the height of 3 feet. These measure now, 1874, 6 feet 8 inches at the same height, having grown at the rate of three-fourths of an inch in circumference a year for thirty-two years. The average diameter at 3 feet was 16½ inches, and, at 5 feet, more than 15½ inches. Rev. J. L. Russell gives me an account of a white-pine which grew in a rocky swamp in Hingham, which, at the age of thirty-two years, gave 7 feet circumference at the butt, and a height from root to top of 62 feet 6 inches, having thus grown almost an inch in diameter, and 2 feet in height annually.

I. 1. Sp. 2. The Pitch-Pine. *Pinus rigida.* L.

Figured in Lambert's Pinus, Plate 16.
Michaux; Sylva, III., Plate 143.
Loudon; Arboretum, VIII., beautifully, Plate 326.
Our Figure.

This tree is distinguished by its leaves being in threes, by the rigidity and sharpness of the scales of its cones, by the

roughness of its bark, and by the denseness of the brushes of its stiff, crowded leaves. It has not usually great beauty, but it produces an agreeable contrast, by the deep green of its foliage, with the lighter colors of the deciduous trees; and there is an irregularity about it which often gives a single tree a picturesque appearance when seen at a distance, and an individual tree is sometimes very beautiful. It is free from the stiffness of most of the other pines, and a hill clothed with it is a desirable addition to a prospect.

The pitch-pine is commonly 40 or 50 feet high, and 1 or 2 feet in diameter at base. In the most favorable situations in which it occurs, which are sands mixed with loam, and plentifully supplied with moisture, it sometimes attains the height of 70 or 80 feet, and even more, with a diameter of nearly 3 feet. Such trees are now very rare. About the ponds in Plymouth, where these pines rise considerably above the uniform growth of oaks, they must be 70 feet high, and I found the average size of several of the largest to be 5 feet and 7 inches in circumference, at 3 feet from the ground. In other parts of the lower counties, I have found the largest sometimes over 6 feet In a single instance, the circumference was 6 feet 7 inches.[1] Dr. E. W. Emerson lately measured for me a large pitch-pine not far from the middle of Concord, towards Boston, and found it 65 feet high; while the girth, at 4 feet from the ground, was $7\frac{1}{2}$ feet. It is a magnificent tree.

On the hills in the south-western corner of the State, they are still found growing to the height of 100 feet; and men are living in Massachusetts and Maine who remember that it was not uncommon to find them of more than 100 feet in height, and 4 or 5 feet in diameter.

[1] One which I measured in Lyman, York County, Maine, was 8 feet 6 inches in circumference at the ground, 7 feet 6 inches at $3\frac{1}{2}$ feet above, and, by the estimation of a friend who was experienced in trees, 90 feet high. Several measured in Chester, N. H., were over 7 feet in girth at the ground, and one was 7 feet at 3 feet from the surface, and 80 feet high.

Full-grown tree at Pain's Hill, 50 ft. high.

[Scale 1 in. to 12 ft.]

PITCH PINE. *Pinus rigida.*

Almost everywhere, however, the pitch-pines form low woods, occupying, together with the little gray birch, tracts of sterile land where few other trees would thrive. The edges and openings among these trees are tenanted by the low, tender blueberry, whose abundant fruit invites, at the season of its maturity, immense flocks of wild pigeons. But at other seasons, nothing can be stiller and more solemn than these forests. The hermit thrush loves to sit in the top of a pine, and charm the woods with his solitary, sweet notes; and, when he is silent, a person sitting on the fragrant decaying leaves or soft moss, at its foot, may listen to the wind singing in its branches. The "going of the wind" among the leaves of the pine, is a peculiar sound. One accustomed to the woods easily distinguishes it from every other sound; and it is not difficult to believe that a practised ear might distinguish every particular tree, without the aid of sight, by the noise of the wind in its foliage.

The root of the pitch-pine penetrates almost at once to the depth of 1 or 2 feet, and hence the difficulty of transplanting the young trees. But the roots of those 40 or 60 feet high, which have been prostrated by the wind, are seldom found more than 2 feet below the surface. The horizontal ones are short, and are covered with a rough bark, which comes off in flakes.

The trunk in dense woods is erect; in more open situations, it is often tortuous, or angled. In the former case, where the limbs have perished at an early stage of the tree's growth, and its increase has depended upon a few branches near the top, the trunk is entirely without branches to a great height, and the wood is clear, and soft, free from knots, and almost free from resin, and, from the slow growth, the bark is less rough than usual. Such trees are called yellow-pines, and are supposed by lumber-men to be of a different species.

The bark of the trunk is excessively rough, deeply cleft, and very dark colored; whence the tree is sometimes called

black-pine. The young branches seem to have no true bark, but to be covered by the decurrent foot of the shrivelled leaf, from which grows the sheath of the bundles of leaves. The surface of every part of the tree is thus more rough than that of any other tree of the forest. But it is less liable to be covered by lichens.[1]

The branches are in imperfect whorls of three or more. So many of the branches perish, that this circumstance is often not visible in a solitary tree, but, to one examining a large number, it is immediately obvious. They usually tend upwards irregularly at a considerable angle, forming large deep masses of foliage; and never, except in very old trees, have the horizontal growth common to most other pines. As the trees usually grow at some distance apart, on extremely poor soil, they are almost uniformly much branched, and the branches are irregular, and larger than in other trees of this family. The leaves are in threes, with a callous point, flattish, rounded on the external side, and angled within, and from 2 to 5 or 6 inches long; arranged in spirals, and forming a stiff brush at the ends of the branches. The buds, which are long and slender, are covered with resin; they are found only at the extremities, where a single large bud is encircled by three or more smaller ones.

The sterile flowers are in catkins, half an inch or more long, in a few spirals around the base of the recent shoot, where they take the place of bundles of leaves. The anthers have two cells, from which is discharged a great quantity of sulphur-colored pollen. The fertile flowers are in cones, which are either solitary or two or more together, near the extremity of the new shoot. At the period of flowering, in May or June, they are one-third of an inch long, on a stout footstalk covered with thin reddish scales. At this period both male and female flowers have great beauty. At the end of one season, the cones

[1] A few Usneas and large Stictas, and occasionally the more vigorous Parmelias, find place on the bark.

Sprague del. Armstrong & Co. lith. Boston

PITCH PINE. (Pinus rigida.)

are not apparently changed in size. At the end of the second, they are sometimes fully, sometimes half grown. When mature, which is usually at the end of the second autumn, although sometimes not till the third, they are of a conical shape, from 2 to 3 inches long, and each scale terminated in a short, acute, stiff spine. Michaux observed that, on solitary stocks exposed to the winds, the cones are constantly found in groups of four, five, or more, and that they then remain closed for several years.

The pitch-pine is found from the Penobscot River in Maine to the mountains of Carolina. On its northern borders it attains a height of only twelve or fifteen feet; on its southern, it is a large tree. The wood of the pitch-pine is hard and firm, and remarkable, except in the variety above mentioned, for the quantity of resin it contains. This is much more abundant in the branches than in the trunk, whence the boards and other lumber of this wood are usually full of pitch knots. When a tree stands some time after its vigorous growth has ceased, the whole heart-wood, and even the whole wood, is filled with resin, and converted into what is called pitch wood. This is so incorruptible, that it is often dug up entire in old pine woods, where it has been exposed for scores of years to alternations of moisture and dryness. The proportion of sap-wood to heart-wood varies in different situations. In a tree of fifty years' growth, the exterior twenty-five circles may be sometimes found of sap-wood.

The pitch-pine is of far more value than it has usually been considered. The variety called yellow-pine[1] is an excellent substitute for white-pine for any purpose to which the latter may be applied. In Plymouth County, vessels have been made, in many instances, for a considerable time past, almost entirely of pitch-pine. For the upper floor, for the lower

[1] This name is also applied to the Southern yellow pine, *Pinus australis*, and sometimes to the Norway or red pine, *Pinus resinosa*, with which there is no danger that any variety of pitch-pine should be confounded by a botanist.

deck, and for the beams, the best oak only is superior. Its principal defect, as a material for ship-building, is the comparatively insecure hold it gives to spikes; making it necessary to substitute, at certain points, pieces of oak timber. It is an excellent material for floors, not yielding to the Southern pine in durability and surpassing it in beauty. For water-wheels, it is preferred, on account of its durability when exposed to alternations of wet and dryness. For the same reason it is selected for pumps, particularly ships' pumps, and also for aqueduct pipes, for which purposes pieces are chosen with little heart-wood. It is also an excellent material for the sills of houses and barns, and for the sleepers of railroads and the stringers of bridges, and for the frame of mills and other structures in damp situations. It has also been made into staves for nail-casks. It is preferred to any other wood in the Northern States as fuel for steam-engines, and vast quantities of it are also consumed for the supply of families. Formerly tar and lampblack were obtained from it. Now, from its increased value and scarcity, this use is rarely made of it.

As the pitch-pine grows commonly on the most barren sands, its growth is not rapid. On sandy plains, too poor for profitable cultivation, and where only a single scanty crop of winter rye could be raised, far too small to repay the labor employed in its cultivation, I have observed the pitch-pines gradually encroaching on the deserted fields, and making an average of twelve or fifteen feet in height in ten years. From the examination of hundreds of trees which have been felled and split, on the same kind of land, and which were generally sixty or seventy years old, it appeared that, for the first sixteen to twenty-five years, the trees had increased in diameter at the rate of from two-ninths to two-fifths of an inch a year. After the twenty-fifth, the circles of growth were uniformly narrower, there being rarely so few as ten to an inch, and often twelve or thirteen. It would thus appear that, on the very poorest land, this tree, when self-planted, increases at the rate of an inch in

diameter in three or four years, for the first twenty-five years, and after that at the rate of one in five or six. In between fifty and sixty years, then, worthless barren sands may be covered with pines of a foot in diameter and forty or fifty feet high.

My friend, the Rev. J. L. Russell, lately of Chelmsford, has given me some very valuable facts upon this point. He says, in a letter dated December, 1839, "Twenty years ago, in sowing a sandy plain with rye, it was necessary to tear up a great many young pitch-pines. This was near the middle of May. The young trees, averaging three feet in height, were thrown into a cart and carried to an abandoned tract of ground, completely inundated with drift sand, and capable of producing merely the most useless weeds. With great haste the trees were planted in this desert, amid the merriment and derision of all who witnessed what was considered so fruitless an undertaking. But the experiment was perfectly successful, and in four straight lines stand at this moment ninety-seven pines, of which number one, and the finest, is a white-pine, all the rest being pitch-pines. They have attained the height of twenty or more feet, and the measures of the circumference of several are appended, as follows: the white-pine, two feet two inches; pitch-pine, two feet four inches; two feet six inches; two feet six and one-half inches; two feet nine inches; two feet ten inches. The average circumference may be estimated at one foot nine inches. Several young trees are springing up beneath this little artificial forest, and the original plantation, beginning to produce seed, will soon cause a perceptible difference in the nature of the plain."

These plants were probably four or five years old when transplanted. We thus find them of a diameter of from seven to ten or eleven inches, or an average of seven for all, in about twenty-five years. Mr. Russell recommends "to transplant when the new shoot or growth is about half an inch in length."

Young trees in every stage of growth may be found along the borders of pine woods, particularly on the edges of ponds and the sandy banks of streams. In the first year they rarely exceed three or four inches in height, but their roots are often many times that length; in the second, they somewhat more than double their growth, but still look very slender and delicate; in the third year, they begin to assume some appearance of vigor, and often reach the height of eighteen inches or two feet. For the first two or three years the leaves are single; afterwards they appear in bundles from the axil of the single leaves. After the third year, the growth in favorable situations is rapid, sometimes at the rate of two or three feet a year. The best age for transplanting is two or three years.

The pitch pine has the great advantage of not being injuriously, at least not fatally, affected by salt water. Michaux observed it growing where the ground was overflowed by the spring-tides; and in many parts of this State it is found nearer to the sea than any other pine. It thus seems adapted[1] to be planted on the extensive sands on Cape Cod, Nantucket, and in some other parts, which are now not only utterly barren and unproductive, but, by being blown about by the winds, are a serious inconvenience to the habitations of man, and threaten to overwhelm the cultivated spots in their vicinity. On the western coasts of the continent of Europe, particularly in Holland, and in Gascony in France, are similar and more extensive wastes of drifting sand, called *dunes* or downs, which, from time immemorial, had been barren. These were tossed about by the winds like the waves of the sea, the whole aspect of the desert being sometimes changed by a storm, valleys taking the place of hills, and hills of valleys. Fields, villages, and even forests, had been overwhelmed by it, and it threatened to extend itself continually inland. "To obviate this evil," says Decandolle,[2] from whom I borrow the

[1] The Scotch fir (*Pinus sylvestris*) is probably better.
[2] *Physiologie Végétale*, p. 1236, Vol. III.

SCOTCH FIR. *Pinus sylvestris.*

account, "the Dutch had for a long time been in the habit of sowing these downs with beach grass (*Arundo arenaria*, L.), that its long matting roots might fix the sand. But if this takes from the sand its power of injuring, it leaves it wholly useless. On seeing the downs of Holland, I was struck with this defect, and pointed out the advantages of planting trees there. I was not then aware that the engineer Bremontier had, as early as 1789, made trial of this very expedient on the downs of Gascony. Its success has since been made public, and I have myself had the pleasure of witnessing it, which I did with unaffected admiration. The process of Bremontier is remarkable for its simplicity. He sows, in the loosest and dryest sand, the seeds of broom (*Genista scoparia*), with those of the maritime pine (*Pinus maritima*), a variety of the cluster pine (*Pinus pinaster*); and covers the surface sown, with branches taken from the nearest pine forest. The object of the branches is to arrest the sand for a time, and keep it from blowing away. The plants of the broom spring up first, and, by their rapid growth, serve to retain the sand in its place and to shelter the young pines. These continue to grow for seven or eight years under the shelter of the broom, the leaves of which annually mingle with the soil and fertilize it. After this period, the pines overtop the broom and often kill it by their shade. At the age of ten or twelve years, they begin to thin the forest to make tar and to get branches for continuing the process of sowing. In about twenty years, they begin to cut down the trees to extract the resin. These forests, situated on the downs along the sea, protect from the continual action of the west wind the whole space situated behind them; and thus, at the same time that they themselves furnish an important product, they secure those of the rest of the country.'

He ends the account by saying, that he has herborized for a whole day in the forests sown by Bremontier on sand completely arid, and on which, before him, scarce a trace of vegetation could be seen.

By pursuing, on the waste sands in many parts of this State, the course which has been so successful in France, forests for fuel and tar and lampblack, and perhaps for ship timber, may be formed on land which is now not only utterly valueless, but in many places inconvenient and dangerous. The plant to be selected to protect the young pine may be the sweet fern (*Comptonia*), or perhaps the very broom which has been used in France, as its seed could be easily imported, and there can be no doubt that it would grow on this side of the Atlantic as well as on the other. Arundo arenaria, which grows readily on our coast sands, might be better.[1]

Another use to be made of the pitch pine, is one to which the Scotch pine, which it much resembles, is put in England, — that of serving as nurse to tender deciduous trees.

There is a circumstance about the pitch pine which I have never observed in any other tree of this family, and believe to be peculiar. Its stump throws up sprouts the spring after the stem has been felled. These continue to flourish, with apparent vigor, for several years; but I have never seen them attain any considerable height. The fallen trunk itself throws out sprouts in the succeeding summer; and the bundles of leaves of both are remarkable for issuing from the axil of a single leaf, in the same manner as is observed in the young plant.

[1] I visited, in the summer of 1872, the region saved by Bremontier, and examined the work he had done and its effects. The whole country, for more than a hundred miles along the Atlantic coast of Gascony, and from four to eighteen landward, had been covered with sand hills, — called by the French, *dunes*. The process of ruin had been going on for centuries, and some of the sand hills were hundreds of feet high. In the midst of this recovered region, I stopped a day or two at a beautiful town, where a hundred thousand persons from Paris and other cities in France, attracted by the genial climate and the health-giving atmosphere of the pine forests, had passed the winter. I walked and drove along the sandy roads, visited a monument to Bremontier erected by his brother, ten miles or more inland, in the redeemed territory, and saw, in many places, deciduous trees — oaks, ashes, beeches, and others — growing luxuriantly under the protection of the pines. One cannot help feeling, while enjoying this, the justice of our countryman Marsh, who counted Bremontier, and Reventloo, who conducted a similar work in Denmark, as among the greatest benefactors of their race." — See *Man and Nature*, pp. 512, 515.

SCOTCH PINE. *Pinus sylvestris.*

I. 1. Sp. 3. The Red Pine. *P. resinosa.* Aiton.

Figured in Lambert's Pinus, Plate 13.
Michaux; Sylva, III., Plate 134; and with our figure of the White pine, p, 73.

The red or Norway pine, has an erect trunk, taller and more slender than that of the pitch pine, which it most nearly resembles. The bark, which is much less rough, is in rather broad scales, of a reddish color. The long leaves are in twos, and the cones are free from the bristling, rigid, sharp points which distinguish those of the pitch pine. It may also be distinguished at a distance by the greater size and length of the terminal brushes of leaves.

This tree is known in New England by the name of the Norway pine, although it is entirely different from the tree so called in Europe, which is a kind of spruce. On this account Michaux proposes to call it the red pine, which name, he says, is given it by the English settlers in Canada. According to the elder Michaux, it is found from 48° north as far south as Wilkesbarre, in Pennsylvania. Mr. Douglas found it in northwest America, along with Lambert's pine. It is nowhere abundant in Massachusetts; but is found, as is usually the case elsewhere, in little detached clumps, in various parts of the State. A grove of about twenty trees, in the edge of Newton, on a cross road leading from Brookline to the Lower Falls, is the only instance in which it occurs in the immediate neighborhood of Boston. It is also found, as I was told by Rev. Mr. Russell, forming a small wood in the town of Chelmsford; and a friend has sent me some young trees from the woods in Concord.

In Maine and New Hampshire, where it is often seen mingling with the forests of white or of pitch pine, it is remarkable for its tall trunk, sometimes 80 feet in height, free from branches, and of nearly a uniform size for 40 or 50 feet or more, and for its smooth, reddish bark.

The branches are in distinct whorls, more regular than those

of the pitch pine, horizontal or inclining first downwards, and curving slightly upwards towards the extremities. The branchlets are stout, and covered with a thick false bark, formed of the foot of the scales from which issue the bundles of leaves running down along the stem.

The leaves are in twos, rarely threes, of a semi-cylindrical shape, six or eight inches long, enclosed at base in very long membranous sheaths, arranged in close spiral lines, and forming large conspicuous tufts or brushes at the end of the branchlets. These showy tufts, which are of a dark green, upon a stem of a handsome shape and of vigorous growth, render the young tree a beautiful object.

The sterile, or male catkins, are at the base, rarely near the end, of the recent shoots, usually on the lower limbs, occupying the place of the leaves for one or two inches, and, like them, rising from the axil of a membranaceous scale. Each cone is three-fourths of an inch long, and one-fifth broad.

The fertile cones are single, or two to four together, around the new bud, at the extremity of the smaller branches on all parts of the tree. At the end of a year, the cones are two inches or more long, egg-shaped, tapering, set with green scales with a brown tip. They become mature in the course of the second season, and may be gathered for seed in the succeeding fall or winter.

The red pine grows as rapidly as the pitch pine, and usually to a greater height, and with a clearer stem, so as to form somewhat longer timber. A few years ago, it was not uncommon to find pine trees of this kind in the southern part of Maine exceeding 100 feet in height, and 4 feet in diameter. The wood is strong, and somewhat durable, and much like that of pitch pine; but it is freer from resin, and softer, having qualities intermediate between it and that of white pine. It was formerly employed, like that of the pitch pine, for the decks of vessels, and sometimes for pumps and for masts; but it is found to be so much inferior in durability, that its use is almost entirely discontinued.

There are several pines, natives of Europe, which might be introduced with advantage into this country. The most valuable of these is the Scotch pine (*Pinus sylvestris*), or Scotch fir, as it is usually called, the only one of the genus which grows naturally in the British Islands (see our figures, one of which represents it as it is seen in the forest). It also grows throughout the north of Europe, and it is from this pine that the masts and other most valuable timber of Norway and the shores of the Baltic are obtained. The English ship-builders esteem the wood as superior to that of any of the American pines. This tree grows with as great freedom and luxuriance here as any of our native trees. The Scotch fir has a striking resemblance to the pitch pine. It is a more beautiful tree, and differs in having its leaves, like those of the Norway pine, in twos.[1]

Another is the cluster pine (*P. pinaster*), a native of the south of Europe, much cultivated in England as an ornamental tree. The Austrian pine (*P. Austriaca*), a fine tree, very much like the red, grows remarkably well here.

Several pines, natives of the western coast of this continent, would probably be propagated without difficulty, and be found of value for their wood. Such are the heavy pine (*P. ponderosa*), from the north-west coast, remarkable for the great weight of its wood; Sabine's pine (*P. Sabiniana*), from the mountains of California; and particularly the gigantic pine (*P. Lambertiana*), from the north-west country, in latitude 43°. This is nearly allied to the white pine.

[1] I have for many years cultivated this pine on a very exposed part of the coast of Boston Bay, and find it hardier, of more rapid growth, and less needing protection, than either of our Massachusetts pines.

I. 2. The Spruce. *Abies.* Jussieu.

The hemlock and the spruce belong to a genus distinguished from the pines in their general appearance, and by the following particular differences: their leaves are solitary, and very short; the male flowers are in solitary aments; the cones are pendulous, or dependent; the scales of the cones are thin at their edge; the fruit comes to maturity in a single year. They are evergreen, resinous trees, of an erect, pyramidal shape, natives of Europe, Asia, and America.

Three species are found in Massachusetts: —

1. The Hemlock has small, pointed, pendulous, terminal cones, and thin, flat leaves.

2. The Black Spruce has dependent, egg-shaped cones, with scales waved and jagged at the edge.

3. The White Spruce has cones longer, also dependent, and spindle-shaped, with scales smooth and entire at the edge.

Both have four-angled, awl-shaped leaves.

I. 2. Sp. 1. The Hemlock. *Abies Canadensis.* Michaux.

Figured in Lambert's Pinus; Plate 45.
Michaux; Sylva III., 149, and beautifully in
Loudon; VIII., from which our Plate is copied.

The hemlock spruce, or hemlock, as, throughout New England it is almost universally called, is the most beautiful tree of the family. It is distinguished from all the other pines by the softness and delicacy of its tufted foliage; from the spruce, by its slender, tapering branchlets, and the smoothness of its limbs; and from the balsam fir, by its small terminal cones, by the irregularity of its branches, and the gracefulness of its whole appearance.

The young trees, by their numerous irregular branches, clothed with foliage of a delicate green, form a rich mass of

SILVER FIR. *Abies pectinata.*

verdure; and when, in the beginning of summer, each twig is terminated with a tuft of yellowish green, recent leaves, surmounting the darker green of the former year, the effect, as an object of beauty, is equalled by very few flowering shrubs, and far surpasses that produced by any other tree.

In the forest, it rises with a uniform shaft 60 or 80 feet, with its diameter but slightly diminished until near the top, when it tapers very rapidly, and forms a head, round and full of branches. Below, it is, when growing in the forest, set with stiff, broken, dead limbs, projecting at right angles to the trunk. The rapid tapering of the extremity of the stem may be noticed at every period of its growth, and forms a striking peculiarity in the appearance of the tree. When growing by itself, it assumes the appearance given in the plate.

The trunk of the hemlock is covered with a reddish bark, somewhat roughened by long, shallow furrows, when it is old, but less so than on many other trees. The branches and small twigs have a smooth, light gray bark. The branchlets are very small, light, and slender, and are set irregularly on the horizontal sides of the small branches, forming with them a flat surface. This arrangement renders them singularly well adapted to the making of brooms, — a use of the hemlock familiar to housewives in the country towns throughout New England. In the disposition of the limbs, there is no approach to the regular stages of whorls, characteristic of the other pines; but they are scattered without order along the trunk, and, being rather small, and horizontal, with an easy sweep upward, render a hemlock of 40 or 50 feet, which has stood alone, the most graceful of the evergreens. The leaves are very small and flat, entire, or with a few minute teeth towards the end, green above, and shining with rows of silvery dots beneath. They are on very small, thread-like footstalks, arranged in spirals around the branch, but disposing themselves, by the bending of the footstalks, in two rows on the sides.

The sterile flowers are on small aments at or near the end

of the smaller branches. Each ament has at its base a few membranaceous brown scales, and, at a little distance above them, an oblong head, one-tenth of an inch long, formed of from ten to twenty heart-shaped, hollow scales, beneath each of which are two cells full of the fertilizing dust.

The fertile aments are on the ends of the outer branchlets. They are egg-shaped, one-fourth of an inch long, and imbricated with green, fleshy scales, within each of which are two raised points, making an opening downwards to a cavity containing the rudiments of the future seed. Without, is a small, jagged, thin scale.

The cones are elliptical and pointed, of a light brown color, three-quarters of an inch long, and three-eighths broad, set upon the extremities of the smallest branches, and pendent on a short footstalk larger than the branchlet, of which it is the end. They consist of about twenty-five to thirty-five entire scales, rounded at the edge, the central ones protecting each two small seeds, which are furnished with wings in size and shape not unlike those of a common fly. The cones are mature in the autumn, and shed their seeds then and during the winter.

The hemlock is said by Pursh to extend to the most northern regions in Canada, and was found by Mr. Menzies in Northwest America; it is found in every part of this State, on almost every variety of soil. It flourishes in the ruins of granitic rocks, on the sides of hills exposed to the violence of the storms. As it bears pruning to almost any degree, without suffering injury, it is well suited to form screens for the protection of more tender trees and plants, or for concealing disagreeable objects. It forms a very beautiful hedge. By being planted in double or triple rows, it may, in a few years, be made to assume the appearance of an impenetrable, evergreen wall, — really impenetrable to the wind and to domestic animals. A hedge of this kind, seven or eight feet high, on a bleak, barren plain exposed to the north-

Abies canadénsis.

The Canadian, *or Hemlock*, Spruce.

Full grown tree at Studley, 60 ft. high; diam of the head, 50 ft.

[Scale 1 in. to 12 ft.]

HEMLOCK. *Abies Canadensis.*

west winds, gave Dr. Greene, of Mansfield, a warm, sunny, sheltered spot for the cultivation of delicate annual plants. When I saw it, the annuals, several of which were rare exotics, were beautiful, but the hemlock screen was much more so.

The hemlock is at first of slow growth, and the delicate, drooping plant looks, for two or three years, as if the sun or the wind would inevitably destroy it. Unprotected and single, it should never be exposed to their influence. In three or four years it lifts up its head, and at last grows, in favorable situations, with great rapidity. Several trees at the Botanic Garden, which, in 1841, had been thirty-one years planted, showed, on careful measurement, an average growth of fourteen inches in diameter at the ground, that is, somewhat less than half an inch a year. The largest of these measured five feet and three inches, the smallest, two feet and nine inches, in circumference.

The timber of the hemlock is wanting in strength, in consequence of having the circles of growth separated at intervals, or, to use the language of the dealers in timber, being "shaky." This defect Michaux supposes to be produced by the winds, acting with great force upon a broad, compact summit rising above the heads of the surrounding trees. Its firmness is great, and it is very durable when not exposed to the atmosphere, but as it has little resin, it ill bears the alternations of moisture and dryness. It is therefore employed, together with spruce, in every part of New England, as a substitute for white pine, where the latter has become scarce, for the frames of all kinds of buildings which are to be covered, for the board covering of wooden houses which are to be clapboarded, and particularly, on account of its hardness, for the threshing-floors of barns. It is preferred to other woods for the material of lathes, and for any purpose where stiffness is wanted without the property of yielding or elasticity, and is excellent for corn-chests, as rats or mice cannot gnaw it. It is much used in the large Atlantic

cities as a substitute for stone in the pavement of streets, for which purpose it is sawn into hexagonal blocks of eight inches in thickness, and eight, ten, or eighteen inches in breadth.

For fuel, it has not great value, as it burns with a great crackling and snapping. It is, however, used in close stoves. Many cords of the bark are annually consumed as fuel. But the most important use to which this bark is applied, and for which it is imported from Maine, is as a substitute for oak bark in the preparation of leather. It contains a great quantity of tannin, combined with a coloring matter which gives a red color to the leather, apt to be communicated to articles kept long in contact with it; on which account, this bark is not commonly used for the best kinds of leather by itself, but mixed with oak bark; and the compound is said to be superior to either alone.

Sp. 2. The Black or Double Spruce. *Abies nigra.* Michaux.

**Figured in Lambert's Pinus; Plate 37.
Michaux; Sylva, III., Plate 147.**

The two species of spruce, the black and the white — or, as they are more commonly called, the double and the single — are distinguished from the fir and the hemlock, in every stage of growth, by the roughness of the bark on their branches, produced by little ridges running down from the base of each leaf, and by the disposition of the leaves, which are arranged in spirals equally on every side of the young shoots. The double is distinguished from the single spruce by the darker color of the foliage, whence its name of black spruce; by the greater thickness, in proportion to the length, of the cones; and by the looseness of the scales, which are jagged or toothed on the edge.

The trunk of the double spruce is perfectly straight, and regularly tapering from the ground to the top. The bark is rather

smooth, covered with thin, narrow scales, which on old trunks become roundish. On the smaller branches and upper part of the trunk, these scales are downward continuations of the leaves, and often come off with them. They are grayish in the middle, edged with brown.

The branches are in whorls of four or more; but, except on small trees, the whorls are not very distinct, in consequence of the premature decay of two or more of the branches, and of the fact that between the whorls are occasionally scattered single limbs. When a tree stands by itself, in a sheltered situation favorable to its growth, the stages or whorls are regularly disposed, and, diminishing gradually in length from the ground to the top, form a conical head of strikingly regular and symmetrical proportions. To the unpractised eye, this mathematical exactness of shape is beautiful, and the spruce is a favorite tree, and is often placed in the near vicinity of houses. But to one studious of variety and picturesque effect, the regular cone becomes stiff and monotonous, and the unvarying dark green of the foliage has a sombre and melancholy aspect.

The recent shoots are pretty large, covered with a light brown surface. The leaves are dark green, two or three fifths of an inch long, and obtusely four-sided, with rows of minute silvery, resinous dots in the grooves, above and below; they end in an abrupt point, and are supported by a minute brown footstalk, which runs down along the bark of the stem. They are very closely arranged in spiral lines,[1] and continue on the tree until, by the growth of the branch, they are one-fourth or one-half an inch asunder, their footstalks dividing the surface into irregular, lozenge-shaped spaces, gradually roughening, until, when the stem or branch is a few inches in diameter, it is covered with small, loose, thin scales.

[1] These are eight, if counted one way, and eleven, if counted another; the leaves and scales of all the pines being so disposed as to form spirals in two directions.

The male flowers are in catkins, situated at the base or towards the end of the branchlets near the terminal buds. They are half an inch to an inch long, and are formed of a central axis or rachis, from which branch stamens on short footstalks, opening on two sides, and ending in a violet or purple, shield-like, lobed, or nearly round disk.

The fertile flowers are in ovoid, erect catkins made up of scales which are of a pale purple, bordered with rose color. They open in May.

The mature cones are egg-shaped, pointing downwards, an inch or more in length, with obovate scales, not closely set, waved, notched, or toothed, and sometimes divided on the edge. They are of a fine dark brown or purple, until mature, when they become pale brown. They ripen in November, but do not open until the following spring. The buds are short, leafy branches, surrounded by delicate, membranaceous scales.

The roots penetrate just below the surface, and then run horizontally in curved lines to eight or ten feet distance. They are covered with a dark red bark, which is scaly on the smaller roots.

There is a superior variety of the double spruce with red wood, often considered a distinct species, and called red spruce. The color is doubtless owing to some peculiarity produced by soil or exposure, as was confidently stated by Michaux.

The tree improves in size, height, and vigor, with the latitude, for some degrees northward of this State. It is probably most perfect in the northern part of Maine or a little further north. It is found in Newfoundland, Nova Scotia, and throughout Canada, to latitude 65°, where it terminates with the paper birch.

Seven spruce trees of thirty-one years' growth, in the Botanic Garden, gave an average of thirty inches in circumference, or one-third of an inch annual growth in diameter.

It rarely grows to a large size. I measured a spruce in Becket, which had a circumference of five feet six inches near the ground, and diminished almost imperceptibly.

The valuable properties of the wood of double spruce are strength, lightness, elasticity, and durability. As combining these in a higher degree than any other wood applicable to the purpose, it is used for the smaller spars of ships, — for all, indeed, except the masts and bowsprits, —in preference to any other except the white or single spruce, and in toughness it is superior to that. It is also sometimes used, in place of oak, or mingled with it, in the upper part of the hull, and is found to outlast the oak, and to possess the requisite tenacity. A builder in New Bedford informed me that a ship over thirty years old had had, during the whole time, a mizzen-mast of spruce, which, when taken out, exhibited no marks of decay. Knees, also, of great durability, are made of the lower part of the trunk and a principal root of the spruce. It is much used for making ladders, and extensively employed in building, being suitable for the smaller timbers in the frames, and for shingles. For these purposes, much spruce timber is brought to Boston from the lower part of Maine, particularly of the variety called red, and in pieces seventy or eighty feet long.

Great quantities of spruce beer are annually made from the recent shoots of the double spruce.[1]

Sp. 3. THE SINGLE OR WHITE SPRUCE. *Abies alba.* Michaux.

Figured in Lambert's Pinus; Plate 37.
Michaux; Sylva, III., Plate 148.

This is a more slender and tapering tree of the swamps, marked by the light color of the bark and lighter green of the leaves. It rarely rises to the height of forty or fifty feet. It is perfectly straight, with numerous, somewhat irregularly scattered branches, forming a head of the same shape as that of the double spruce, but less broad, and with foliage of a less

[1] This beer is said to be made by boiling the fresh branches of spruce until the bark is loosened, mixing with the decoction roasted oats or barley and toasted bread or biscuits, sweetening with brown sugar or molasses, and causing the liquor to ferment, by means of yeast.

gloomy color, whence its name. The bark is of a light brown, somewhat roughened by scales an inch broad and of somewhat greater length.

The shoots are slender, of a light brown or yellowish color, the bark seeming to be made up, as in the other species, of small, roundish ridges, formed of the footstalks of the leaves extending downwards and ending at a leaf below. The leaves are of a light bluish green, in spirals rather closely set, and equally on all sides of the shoot. On the horizontal branchlets, the short footstalks of the leaves on the under side are so bent as to bring all the leaves to the upper half of the branch. The leaves usually fall off in two or three years, leaving a scaly surface, bristling with the short, persistent footstalks. These gradually disappear, and the loose scales enlarge with the growth of the branch.

The root is remarkable for its toughness, and from it the Canadian Indians make the threads with which they sew together the birch-bark for their canoes.

The cones, which are pale green when young, and afterwards pale brown, vary in size extremely. As they grow here, they are from three-quarters of an inch to one and one-half inches long, nearly cylindrical in shape, or somewhat tapering, with rounded ends. In Canada, they are often three inches long. The scales are close set, and perfectly smooth and entire on their edge.

The single spruce is thought to possess the excellent properties of the other species in an equal degree, and is preferred, when it can be had, for the lighter spars of vessels, on account of the smoothness and beauty with which it works. It is found farther north than any other tree of America, and in latitude $67\frac{1}{2}°$ attains the height of twenty feet or more.[1]

This tree has considerable rapidity of growth. Seven trees in the Botanic Garden, Cambridge, which had been planted thirty-one or thirty-two years, measured, one, 2 feet 10 inches;

[1] *Hooker's Fl. Bor. Am.* II., 163.

one, 2 feet 9 inches; three, 2 feet 5 inches each; one, 2 feet 4 inches; and one, 2 feet 3 inches: giving, on an average, a diameter of ten inches in thirty-one years, or a growth of somewhat less than one-third of an inch annually.

I. 3. The Fir. *Picea.* Link.

The firs are lofty trees, social inhabitants of the colder regions of both hemispheres, and often forming vast woods. They are remarkable for the regularity and symmetry of their pyramidal heads. The leaves are solitary, needle-shaped, rigid, sempervirent, supposed by botanists to be formed of two, grown together. They are distinguished from the other pines by the smoothness of their bark, in which are formed cavities or crypts containing their peculiar balsam, by the silvery whiteness of the under surface of the seemingly two-rowed leaves, and by their long, erect cones, formed of woody, deciduous scales, with a smooth, thin edge.

Sp. 1. The Balsam Fir. *Picea balsamifera.* Michaux.

Figured in Lambert's Pinus; Plate 41.
Michaux; Sylva, III., Plate 150.
Loudon; Arboretum, VIII., Plate 334.

This beautiful evergreen resembles the spruce in its regular, pyramidal form. It differs from it in its bark, which is smooth when young, and continues so until the tree has attained considerable age; in its leaves, which are nearly flat, and of a beautiful silvery color beneath; and in having large, upright cones. It has a strong resemblance to the silver fir of Europe, a much loftier and nobler tree. The American tree is known by the name of fir balsam, or balsam fir, or, simply, fir.

The root of the balsam fir, like that of the other pines, penetrates to a small depth, — in young trees, not more than a foot, — and extends horizontally to the distance of five or six, rarely

ten feet, covered with a bright red or crimson bark, which separates in thin scales. The trunk is perfectly even and straight, and tapers regularly and rapidly to the top. It is a thrifty grower, and the young shoots are stout and large, and covered with a green bark striate with gray. They are close set with leaves in regular spirals, which continue many years, becoming more and more remote by the growth of the stem, and, when they fall, leaving a large, oval, horizontal scar of great permanence. The bark becomes, from year to year, of a deeper green, and remains smooth, swollen at intervals with the vesicles produced by the crypts containing the balsam, and in the larger stocks, on its native mountains, blotched with membranaceous lichens.

The branches — which, in young trees incline upward, and on older ones become nearly horizontal, with a slight upward sweep — are in whorls of about five, often with the regularity of the branches of a chandelier, with occasionally scattered, solitary limbs between. The leaves are sessile, from one-fourth of an inch to an inch in length, smooth, narrow, pointed, green with faint white lines above, with a silvery blue tinge beneath, produced by many lines of minute, shining, resinous dots. Arranged in spirals, they spread equally on every side of the stem or branch; but, when the latter is horizontal, they so bend upwards from the lower side as to seem to form but two rows, or to be crowded on the upper side.

The buds, round and small, are enveloped in resin. Those on the ends of the principal and larger shoots are surrounded by about five smaller ones; those on the lateral shoots are single, or two or three together; and solitary buds are scattered irregularly at various points.

The stamens are in oblong heads or aments, one-fourth of an inch long, rather densely crowded on the lower side, near the extremity of the branches. Each ament is on a short footstalk, which rises from a cup-like, irregular scale, in the axil of a leaf.

NORWAY SPRUCE. *Pinus excelsa.*

The cones are erect, near the ends of the upper branches, from two to four inches long, and an inch or more thick, nearly cylindrical, or a little tapering, with the ends rounded, and set on very short, stout footstalks. They are made up of broad, round, bluish purple scales, outside each of which is a scale resembling a transformed, winged leaf, and within are two seeds, with short, broad, purple wings. They stand in great numbers on the uppermost branches, and, by their soft purple color, produce a fine effect.

The balsam is gathered, in small quantities, by puncturing the tubercles in the bark, and receiving it in a cup, or shell, or an iron spoon. The process is a slow one, and the turpentine, which, under the name of *balsam of Gilead*, or *Canada balsam*, is reputed to have great virtues in pulmonary complaints, is sold at a high price in this country and in England. A valuable varnish for water-colors is prepared from it.

The wood of the fir is of little value, as it is deficient in hardness, strength, and elasticity; and the tree does not often attain a large size. It is hardy, easily transplanted, and grows rapidly and with great vigor, and possesses in a high degree the most important qualities of the evergreens as an ornamental tree, — a regular pyramidal shape, and rich, deep green foliage. The large cones, with which the upper branches are often loaded, give it additional beauty. Its defects are its stiffness, and the raggedness which it assumes in old age, which comes on early, as it is a short-lived tree.

Its chief recommendations are its hardiness, and quickness of growth. It stands unprotected against the wind, when not blowing from the sea, better than any other tree, and grows on a bleak point where any other would be killed. Of several firs in the Botanic Garden, which had been planted in 1809 or 1810, the largest measured, in 1841, after it had been thirty-one years planted, 4 feet 2 inches, at the ground, and 3 feet 5 inches, at 3 feet. One, planted in 1814, measured 3 feet 10 inches at the ground, 2 feet 6 inches at 3 feet; and one,

planted in 1819 or 1820, measured 3 feet 1 inch at the ground; giving an average growth of more than half an inch in diameter a year. The balsam fir is found, according to Dr. Richardson, in Canada and Nova Scotia to the Saskatchawan.

A mass of crowded branches, with minute, altered leaves, is sometimes found on the fir, similar to what will be hereafter spoken of as occurring on the red cedar.

The European silver fir (the abies pulcherrima of Virgil), so similar and so superior to the balsam fir, and which sometimes attains to a height of 100 or 150 feet, and even more, grows with great vigor in our gardens and nurseries, and wherever else it has been tried. It is an inhabitant of the mountains of the south of Europe.[1] The Norway spruce seems equally well adapted to our soil and climate. It is the loftiest tree of Europe, and every way worthy of cultivation here. In Winship's nurseries, where it has been introduced a few years, it outstrips our native spruces. But still more remarkable and desirable trees of this genus are found on the western side of the continent, within the limits of the territory of the United States. Such is the tree called Douglas's spruce fir (*A. Douglàsii*), from the name of the person who introduced it into England. In its native forests, it varies from 2 to 10 feet in diameter, and from 100 to 180 feet in height; and a stump is mentioned as still found on the Columbia River, which measures 48 feet in circumference at 3 feet from the ground, exclusive of its very thick bark.

Sp. 2. The Double Balsam Fir. *P. Fraseri.* Pursh.

Figured in Lambert's Pinus; Plate 42.

This tree has so strong a resemblance to the common fir, that it is difficult, except by the cones, to distinguish them. They have the same habit, the same kind of bark, and grow in similar situations. The double fir has its leaves usually much more

[1] See our plate of this, Picea excelsa of Lamarck.

crowded, whence probably its name. It is not often distinguished, however, by the common people. The mature cone presents a ready and certain distinction. It is of about half the length, and two thirds the thickness, of that of the common fir; and the bracts, or transformed leaves inside the scales of the cone, project and are bent back over the scales, and end in a somewhat long point, like the point of a leaf.

From the great richness and luxuriance of the foliage, the double balsam is a very beautiful tree, and its leaves diffuse a peculiarly agreeable, resinous odor. It has been successfully transplanted in Vermont, and, in some instances, in this State, and is valuable as an ornamental tree.

Mr. Fraser discovered this tree on the high mountains of Carolina; and Pursh, who calls it Fraser's pine, found it on the Broad Mountains in Pennsylvania. I have seen it nowhere in this State, except on the top of Saddleback Mountain. It is found on the Green Mountains in Vermont, and on Mount Washington in New Hampshire, and, mingled with the common fir, in the moist woods in Maine. It is a small tree, of the height of 30 feet, with a diameter of 20 inches.

I. 4. The Larch. *Larix.* Tourneforte.

The larches are deciduous trees of cold and mountainous regions of both continents. They are distinguished from the other pines by their leaves, which grow many together, in bundles from the top of buds whose scales are as persistent as the leaves. The wood of the larches is remarkable for its hardness and durability.

I. 4. The Hacmatack. *Larix Americana.* Michaux.

Two varieties figured in Lambert's Pinus; Plates 49, 50.
Also figured by Michaux; Sylva, III., Plate 153.
The tree by Loudon; Arboretum, VIII., Plates 346, 347.

The American larch, known very generally in New England by the aboriginal name of hacmatack, is not often, in this State,

a tall tree. In deep forests it sometimes attains the elevation of 70 feet, but does not usually exceed half that height. It is distinguished from all others of the family by its crowded tufts of deciduous leaves; from the European larch, by the smallness of its cones and the shortness of its leaves.

It has a straight, erect, rapidly-tapering trunk, clothed with a bluish gray bark, rather rough, with small roundish scales. The branches are numerous, very irregular, and horizontal, or nearly so. The recent shoots, which are very slender, have a grayish red bark, which on older branches becomes brown, and, finally, as on the trunk, blue gray.

The leaves are an inch long, in circular tufts round a central bud, except on the growing shoots, where they are alternate. They are linear, flattened, obscurely four-sided, sessile, and obtusely pointed at the end, of an agreeable light bluish green, and differ from those of all the other cone-bearing trees by the delicacy of their texture. Late in autumn they turn to a soft, leather yellow color, and, in the first days of November, fall.

The sterile flowers are in solitary, erect catkins, which take the place of the fascicles of leaves towards the ends of the branches; they are nearly round, one-fourth of an inch long, and composed of rounded, yellow anthers, closely arranged. The fertile flowers are in erect, solitary catkins, about the middle of the branches, half an inch long, and made up of a few floral leaves or scales. Around the base of the catkins are other scales, resembling leaves half transformed, by a dilated wing on each side, into fertile scales. The true scales have a projecting point when in flower, but afterwards become nearly circular, slightly bent in at the edge, and have, within each, two seeds with a scaly wing; the scales and wings are of a pleasant crimson red. The flowering season is May.

The range of the hacmatack is from the mountains of Virginia to Hudson's Bay. At Point Lake, in latitude 65°, it attains, according to Dr. Richardson, to the height of only 6

[illegible] del. Armstrong & Co. lith. Boston

AMERICAN LARCH (Larix Americana)

to 8 feet. It is found in cold swamps in most parts of this State; but attains its greatest perfection in a region considerably farther to the north.

The wood of the larch is very close-grained and compact, of a reddish or gray color, and remarkable for its weight, and its great strength and durability. In these respects, it is superior to all the other pines, and is surpassed only by the oak. Its durability is even superior to the oak itself; and in old vessels, the timbers made of hacmatack have been found entirely sound, when those of white oak were completely decayed. On these accounts, it is preferred before all other woods, for knees, for beams, and for top timbers. The ship-builders make two varieties of the wood, the gray and the red, of which the latter is considered best. Its great hardness makes it valuable for steps in exposed situations; and its compactness gives it great power of resisting the action of fire, and renders it nearly incombustible, except when splintered. It would be better than any other wood in buildings intended to be fire-proof.

On account of the very valuable qualities of the wood, the hacmatack would deserve to be extensively cultivated; and there are thousands of acres of cold and swampy land, where it was found naturally, which are now unproductive, and which might be clothed with it. It has, however, been found to be far inferior in rapidity of growth to the European larch, which very nearly resembles it in appearance, and in the excellent qualities of its wood. This, therefore, should be preferred, as likely to produce, in the same time, a larger quantity of timber from the same surface and at the same expense.

On favorable soils, the European larch is fit for every useful purpose in forty years' growth. Its annual rate of increase in Scotland has been found to be from one to one and a half inches in circumference at six feet from the ground, on trunks from ten to fifty years of age. It has, moreover, the property of flourishing on surfaces almost without soil, thickly strown

with fragments of rocks, on the high and bleak sides and tops of hills, where vegetation scarcely exists. It was in such situations as this, of a description which answers but too well to many waste spots in Massachusetts, that the most successful experiments were made in Scotland by the Dukes of Athol. These are so interesting in themselves, and so deserving of imitation, that a brief account of them cannot be considered unacceptable or out of place here.[1]

The estates of the Dukes of Athol are in the north of Scotland, in the latitude of nearly 57° north. Between 1740 and 1750, James, Duke of Athol, planted more than twelve hundred larch-trees, in various situations and elevations, for the purpose of trying a species of tree then new in Scotland. In 1759, he "planted seven hundred larches over a space of twenty-nine Scotch acres, intermixed with other kinds of forest-trees, with the view of trying the value of the larch as a timber tree. This plantation extended up the face of a hill from two hundred to four hundred feet above the level of the sea. The rocky ground of which it was composed was covered with loose and crumbling masses of mica slate, and was not worth above £3 a year altogether." His successor, John, Duke of Athol, "first conceived the idea of planting larch by itself as a forest-tree, and of planting the sides of the hills about Dunkeld." He planted three acres with larches alone, at an elevation of five or six hundred feet above the level of the sea, on soil not worth a shilling an acre. His son, Duke John, continuing the execution of his father's plans, had planted, in 1783, two hundred and seventy-nine thousand trees. Observing the rapid growth and hardy nature of the larch, he determined to cover with it the steep acclivities of mountains of greater altitude than any that had yet been tried. He therefore enclosed a space of twenty-nine acres, "on the rugged summit of Craig-y-barns, and planted a strip entirely with larches, among the crevices and hollows of the rocks, where

[1] *Highland Society's Transactions* as quoted in *Loudon's Arboretum*, 2359, *et seq.*

LARCH. *Larix Europæa.*

the least soil could be found. At this elevation, none of the larger kinds of natural plants grew, so that the grounds required no previous preparation of clearing." This plantation was formed in 1785 and 1786. Between that year and 1791, he planted six hundred and eighty acres with five hundred thousand larches, the greater part only sprinkled over the surface, on account of the difficulty of procuring a sufficient number of plants.

"Observing with satisfaction and admiration the luxuriant growth of the larch in all situations, and its hardihood, even in the most exposed regions, the duke resolved on pushing entire larch plantations still farther, to the summit of the highest hills." He therefore determined to cover with larch sixteen hundred Scotch acres, "situated from nine hundred to twelve hundred feet above the level of the sea."

These, with four hundred acres more, occupied from 1800 to 1815. "Having now no doubt whatever of the successful growth of the larch in very elevated situations, the duke still farther pursued his object of covering *all* his mountainous regions with that valuable wood. Accordingly, a space to the northward of the one last described, containing 2,959 Scotch acres, was immediately enclosed, and planted entirely with larch.

"The planting of this forest appears to have terminated the labors of the duke in planting." He and his predecessors had planted more than fourteen millions of larch plants, occupying over ten thousand English acres. It has been estimated, that the whole forest on mountain ground, planted entirely with larch, about six thousand five hundred Scotch acres, will, in seventy-two years from the time of planting, be a forest of timber fit for building the largest ships.

The effect upon the land in improving it for pasturage is very important. If the larch-trees are planted close, they will choke the bushes and natural grasses. This may be effected in ten or fifteen years. After this, gradual thinnings may be

accompanied by the introduction of all the most valuable cultivated grasses, which, under the cover of the larches, will flourish "with the foliage possessing a softness and luxuriance not possessed in other situations." Vast sums have been realized by the successor of this duke from his plantations on the Scotch mountains.

There are large surfaces, particularly in Essex and Bristol counties, of bleak, rocky, barren hills, or wet plains, not so exposed as that spoken of above, but almost equally useless, which might doubtless be redeemed by a similar process. We have now to send to the Southern States, and to New York and Maine, for a great portion of our ship timber. Of this the live oak and white oak alone are superior to larch, and for many purposes they are only equal to it. In seventy years, the ship-yards on Mystic River, and on Buzzard's Bay, might be supplied with timber from the neighboring shores, if the land suitable for that purpose, and for little else, were immediately to be planted with larch. In half that space of time, the thinnings of the forest would furnish the smaller timber in abundance. It may safely be predicted, that, if measures are not taken to restore or preserve our forests, if the same waste goes on which has gone on for the last fifty years, in seventy years timber of every kind will be as rare and as dear in New England as it now is in Scotland.

On the continent of Europe, the larch is put to a great variety of uses. It is considered the best of the woods, both for the carpenter and the joiner. Casks are made of it, nearly incorruptible; water-pipes, shingles, vine-props. Its excellent properties for ship-building, as enumerated by Pontey, are its freedom from knots, its durability, its little liability to shrink or to crack, its toughness, its beautiful color, its capability to receive polish, and its incorruptibility when exposed to alternations of moisture and dryness.

The soils suitable for the larch, according to Matthew,[1] are

[1] As quoted by Loudon, p. 2376.

CEDAR OF LEBANON. *Cedrus Libani.*

sound rock, with a covering of loam, particularly when the rock is jagged or cleft; gravel, not ferruginous, in which water does not stagnate, even though nearly bare of vegetable mould; firm, dry clays, and sound, brown loam; all very rough ground, particularly ravines. The most desirable situation is where the roots will neither be drowned by stagnant water in winter, nor parched by drought in summer.[1]

The magnificent cedar of Lebanon (*Cedrus Libani*) resembles the larch more than it does any other of our pines; differing in having its leaves, which are arranged in the same manner, evergreen, in the greater size of its cones, and its broad, spreading top. This tree has nearly disappeared on Mount Lebanon, but is found growing naturally, in great numbers, on a branch of the Taurus Mountains, in Asia Minor.[2] It is successfully cultivated, as an ornamental tree, in every part of Great Britain and in France, and would doubtless succeed in the warmer parts of New England.

SECTION SECOND.

THE CYPRESS TRIBE.

The plants which belong to this section have not their fruit in a true cone, but in a globular, or irregular head, consisting of a small number of scales, sometimes united into a sort of berry. The section includes the Arbor Vitæ, the Juniper, the Red and the White Cedar, the Cypress, and the exotic genus Callitris. Most of the section are natives of warmer climates. Those which belong to New England are evergreen, but scarcely resinous. They may be propagated by layers or cuttings, but more readily by seeds, which generally lie in the ground a year. The young plants are to be treated like the pines.

[1] A very valuable account of every thing relating to the whole cultivation, management, and uses of the larch, is found in *Loudon's Arboretum*, pp. 2353 to 2399.

[2] *Fig. Veg. World*, p. 329.

I. 5. Arbor Vitæ. Cedar. *Thuya.* L.

The name of this genus is derived from a Greek word (*θύω*) signifying to sacrifice; it having been used, from the agreeable odor of the wood, in sacrificial offerings. The thuyas are narrow, pyramidal, evergreen trees or shrubs of Asia, Africa, and North America. The cones are ovoid, of a few scales, of which the two exterior are shortened and boat-shaped.

Sp. 1. The American Arbor Vitæ. *Thuya occidentalis.* L.

Figured by Michaux; Sylva, III., Plate 156.
The tree, flower and fruit, by Loudon; Arboretum, VIII., Plate 302.

This is a rare inhabitant of Massachusetts. In favorable situations it is sometimes, according to Michaux, a tree of 40 or 50 feet in height, with a trunk 10 feet in circumference. But usually it is not more than ten or fifteen inches in diameter at five feet from the ground. The trunk is rarely straight, and is often swollen in large ridges above the principal roots. "The bark is slightly furrowed, smooth to the touch, and very white when the tree stands exposed. The wood is reddish, somewhat odorous, very light, soft, and fine-grained. In the northern part of the United States, and in Canada, it holds the first place for durability. From the shape of the trunk it is difficult to procure sticks of considerable length and a uniform diameter; hence, in Maine, it is little employed for the frame of houses, and still less for the covering. It is softer than white pine, and gives a weaker hold to nails, for which reason the Canadians always join with it some more solid wood." [1] It is most commonly used for fences, in which the posts, set in clayey land, last thirty-five or forty years, and the rails last sixty. It is also used in Canada for the light frame of bark canoes. Its twigs are formed into brooms, which exhale an agreeable aromatic odor.

[1] *Sylva*, III. 229.

THE STONE PINE. *Pinus pinea.*

YOUNG CEDAR. *Cedrus Libani.*

Michaux says that his father, in 1792, found the mission-house built by the Jesuits near Lake Chicoutomé, in latitude 48°, of square beams of this wood, laid one upon another, without covering on either side, remaining perfectly sound after more than sixty years.

Dr. Richardson found this tree from Lake Huron to the Saskatchawan.

The smaller branches are of a yellowish-brown color, regularly set with opposite, scale-like, adhering leaves, with the margins and point slightly projecting. The leaves are evergreen, arranged in four rows, in alternately opposite pairs, completely investing and seeming to make up the fan-like branchlets. They are scale-like, marked with a projecting gland below the point, each lower pair embracing and covering the base of the pair above. The branchlets which they cover are arranged in a single plane, as if they were parts of a large compound, flat, pinnate leaf. These planes are variously inclined to the horizon, often vertical, and form the striking peculiarity of this picturesque tree.

The male and female flowers are on different parts of the same plant. The male flowers are very minute, four or six in number, in alternately opposite pairs, forming, together, a small terminal ament one twelfth part of an inch long, on a very short footstalk. Each flower consists of a roundish, shield-like scale, protecting two, three, or four anthers. The female flowers consist of six to twelve reddish, dark-pointed scales, on the sides or ends of the branches. They slightly resemble transformed leaves, each holding in its bosom two bottle-like ovaries. The cones are of a light brown color, three-eighths of an inch long, consisting of from six to twelve loose, oblong, rounded scales, protecting each two seeds, which are edged by a narrow wing on each side.

The arbor vitæ is interesting from its association with the grand and beautiful objects near which it is commonly seen growing wild, such as Goat's Island at Niagara, and the steep

banks of West Canada Creek at Trenton Falls. It is found only in cool and moist situations, but may be cultivated in any ground not too dry. Its fantastic and singular shape recommends it to be planted for the embellishment of water-falls, and as a beautiful single tree.

I. 6. Cedar or Cypress. *Cupressus.* Tourneforte.

The cypresses — for to this genus our white-cedar belongs — are low, evergreen trees, natives of Europe, Asia, and North America, and remarkable for their spiry form, and the closeness of grain and the durability of their wood. They have a roundish or polyhedral cone, called a galbule, and small, imbricated, scale-like, four-rowed leaves. By the ancients, the cypress was considered an emblem of immortality; with the moderns, it is emblematical of sadness and mourning.

> Dark tree! still sad, when others' grief is fled,
> The only constant mourner of the dead. — *Byron.*

The White Cedar. *Cupressus thyoides.* L.

Figured by Michaux; Sylva, III., Plate 152.

This is always a graceful and beautiful tree. Even when growing in its native swamps, hemmed in on all sides, and struggling for existence, the top and a branch or two near the top will be marked by a characteristic elegance of shape which no other tree of the family possesses. It is entirely free from the stiffness of the pines; and to the spiry top of the poplar and the grace of the cypress, it unites the airy lightness of the hemlock.

The white cedar connects the arbor vitæ with the cypresses. It has the characters of both; the scale-like, imbricate leaves and fan-shaped branches of the former, and the lofty port and globular or many-sided fruit of the latter.

In Massachusetts, it grows only in swamps which are inundated for the greater part of the year. Several of these, as

between Boston and Mansfield, and Taunton and New Bedford, have been penetrated by railroads ; but before then, the trees were nearly inaccessible, except in the middle of summer, or the heart of winter. The trunk is very straight and tall, tapering very gradually, and, towards the summit, set with short, small, nearly horizontal, irregular branches, forming a small but beautiful head, above which the leading shoot waves like a slender plume. The bark on the smaller branches is of a brownish or purplish green, often mottled with white lichens. On the trunk, it is reddish, scaling off in thin scales, thready, and broken on the upper part by furrows, which are deeper nearer the base on old trees. These are long, and run in a spiral line round the trunk once in thirty or more feet, indicating a corresponding twist in the fibres of the wood. The smaller branchlets are crowded, and irregularly divaricate or fan-shaped, like those of the arbor vitæ. The recent shoots have a few opposite leaves scattered along their sides, the bases of which seem to form a part of the greenish bark. In two or three years, these leaves, with a portion of bark adhering to them, scale off, leaving the purplish brown bark of the branches and young stocks perfectly smooth and resembling the bark of a cherry-tree. The leaves are very small, scale-like, with triangular, sharp points, and imbricate in opposite pairs, forming four rows, completely covering the compressed, ultimate branchlets, which seem to be compound leaves. Each leaf has, like those of the arbor vitæ, a minute tubercle on the back, near the base.

The flowers are extremely minute. The male consists of several shield-like scales, protecting about three stamens ; the female, of a few opposite pairs of thickened scales, containing each two ovules, in bottle-shaped sacs. The fruits are compound, globose, or many-sided (about ten) cone-like heads, of the size of a large pea. These are at first green, afterwards turn blue, and finally brown. They are mature in autumn, when they begin to cast their minute, oblong, flat-

tened seeds; but they usually remain on the tree for some time after.

The wood is white, or, when seasoned, of a faint rose color, light, soft, fine-grained, and very durable. It has a strong and permanent aromatic odor; and it resists for a long time the alternations of moisture and dryness. It is hence particularly suitable for fencing, for which purpose it is much used in the neighborhood of the cedar swamps. It is also employed in making shingles and wooden vessels. For its lightness and durability, it is chosen for certain parts of whale-boats, for the streaks, ceiling or lining, platform, and stern-sheets; the frame-work being made of oak.

In their native swamps, the white cedars usually come up so thickly as almost to cover the ground, and, when grown to the height of eight or ten feet, they form a perfectly impenetrable thicket. In this state they nearly cease to grow, and remain apparently stationary, till the hardier stocks outgrow, overshadow, and choke the weaker ones. These latter gradually die, making room for the slow growth of the survivors. If, at this stage, four out of five, or even nine out of ten, were thinned out, the remainder would be able to grow to an amount fully equal to the whole. This should always be done. The thinnings are an excellent material for fences. On the grounds of the late Joseph Anthony, of New Bedford, was a fence made of small white cedars, of a fashion worth imitating. A row of cedar stakes is set, at suitable distances, leaning all one way, at an angle of 45°. In contact with them another row is set, with the same inclination in an opposite direction. Where the contiguous stakes cross each other, they are fastened together with some pliant twig, like the young shoots of blue-fruited dog-wood (*Viburnum nudum*). Thus is formed a sufficient and ornamental fence, of great durability.

The white cedar has so many excellent qualities, that, in an industrious and manufacturing community, it can never cease

CYPRESS OF SOMMA. *Cupressus sempervirens.*

to be valuable. It is one of those trees, therefore, which ought to be cultivated in great numbers, to supply the wants of posterity. Fortunately, it is one which can be cultivated with less trouble and at less expense than any other forest-tree, and it conflicts with no other. There are large tracts of cold, swampy land, which could be drained only at great expense, which might, in their present state, be made to produce valuable forests of this tree. It would be only necessary to gather the seed from the forests already growing, and cast it abundantly, in the fall of the year, upon the surface of the ground or water, in the morasses and swamps intended for this use. In six or eighteen months, the seeds will vegetate. In a few years, thinnings might be made, which, for enclosures alone, would pay a high rate of interest upon the value of the land and of the labor bestowed.

There are several trees of the cypress kind that should be introduced for their beauty. The common cypress of Europe, a tall and graceful, plume-shaped tree, the common and suitable ornament for burying places in the Levant, succeeds in the open air in various parts of Britain, and would probably succeed in sheltered places here. Perhaps the oldest tree on record is the cypress of Somma, in Lombardy. It is supposed to have been planted the year of the birth of Jesus Christ, and, on that account, is looked upon with reverence by the inhabitants; but an ancient chronicle at Milan is said to prove that it was a tree in the time of Julius Cæsar, B. C. 42. It is 121 feet high, and 23 feet in circumference at one foot from the ground. Napoleon, when laying down the plan for his great road over the Simplon, diverged from a straight line to avoid injuring this tree.

A still more beautiful tree, not an evergreen, is the cypress of the Southern States (*Taxòdium dístichum*). This is a noble tree. It often rises to the height of 120 feet. In Bartram's garden, a tree of this species is the chief ornament of

the place, among the best collection of trees in North America. At the Botanic Garden, Cambridge, it grows perfectly well, and has never been visibly affected by the severity of our winter.

I. 7. The Juniper. *Juniperus.* L.

The junipers are evergreen trees or shrubs, found in all quarters of the globe. They are distinguished by their fruit, which is a three-sided, berry-like galbule, made up of several thickened, fleshy, coalescing ovaries, and usually covered with a bluish bloom. The leaves are opposite, or in whorls, narrow, stiff, and pointed, sometimes minute and scale-like. The wood is more or less aromatic, and is very durable. The berries are employed in medicine as a diuretic, and to give its peculiar flavor to gin.

The species in Massachusetts are, 1. The Red Cedar, which is a small tree; and 2. The Common Juniper, a prostrate shrub.

Sp. 1. The Red Cedar. *Juniperus Virginiana.* L.

Figured in Michaux; Sylva, III., Plate 155.
By Bigelow; Med. Bot. III., Plate 45.
And in Loudon's Arboretum; VIII., Plate 298.

This is usually a ragged-looking tree. In the neighborhood of Boston, it is commonly found on dry, rocky hills, where it sometimes attains the height of 30 or 35 feet. When it grows by itself on the open ground, it throws out several large limbs close to the earth, which, extending horizontally a few feet, and sometimes taking root, sweep upwards, and often almost equal the main stem, forming together what seems to be a clump of small trees, rather than a single tree. Surrounded by other trees in a wood, it has a smooth, clear trunk for 12 or 15 feet, and a handsome, spiry head. On the rocks

RED CEDAR. *Juniperus Virginiana.*

it assumes every variety of form,— round-headed, irregular, or cone-shaped, sometimes of very great beauty, and strongly resembling, as seen from a distance, the common cypress of Europe.

The red cedar is distinguished from the white and the arbor vitæ, the only trees which it resembles, by having its fruit in the form of a berry, and its leaves exhibiting but slightly a tendency to arrange themselves in a plane. The trunk is straight, rapidly decreasing, and full of branches. It is often deformed by holes produced by the loss of branches, and by knots left in the attempt to make it a shapely tree by pruning. It is covered with a bark, reddish within, and usually rough externally, with long, stringy, brownish, loose scales, or ribbons, but, when long exposed, smooth and whitish. The furrows separating the stringy scales often take a slightly spiral direction, indicating a twist in the woody fibre similar to what is observed in the white cedar. The lateral, crowded, leafy twigs are alternate, and made up of four rows of leaves, imbricately arranged in opposite pairs, and connected by a thread of woody fibre. The leaves are very short, minute, fleshy, convex, and pointed, but not sharp, with a depressed gland on the outer side; each pair closely embracing the lower margin and base of the pair above it. On the growing shoots, the leaves are much longer, rigid, and sharp-pointed, in opposite and somewhat distant pairs, or threes. These leaves gradually turn light brown, like the bark, and in a few years scale off, leaving the now purplish bark perfectly smooth, which it continues to be till the branch is an inch or two in diameter, when the epidermis begins to crack and scale off. "A singular variety sometimes appears in the young shoots, especially those which issue from the base of the trees. This consists in an elongation of the leaves to five or six times their usual length, while they become spreading, acerose, considerably remote from each other, and irregular in their insertion, being either opposite or ternate. These shoots are so dissimilar to the

parent tree, that they have been repeatedly mistaken for individuals of a different species."[1]

The barren and fertile flowers are on different trees, rarely on the same. The barren flowers are in small, terminal, oblong, yellowish brown aments, from one tenth to one fifth of an inch long, formed of four to six pairs of shield-like scales, each protecting about four yellow anthers. The fertile flowers are still more minute. They consist of, usually, six fleshy, oblong, obtuse, bluish, or violet scales, in pairs or threes, united at base, and containing one or two bottle-shaped, covered ovaries or germs.[2] About these germs the swelling scales coalesce, and form a roundish, or obscurely four-sided berry, which is green, covered with a bluish powder, and marked with minute projections, indicating the points of the once distinct scales. The seeds are one or two, covered with a bony shell, in the shape of a short cone, which is compressed on one side when there are two. The flowers open in April or May, and the fruit is mature in October or November, but continues on the tree through the winter.

Though usually having little beauty, it may be made a handsome low or middle-sized tree, by careful pruning when young. If this is attempted too late, the tree is deformed by numerous knots. When growing in a dry but rich soil, in a sheltered situation, it is sometimes a fine tree. In the Park of Philadelphia are many red cedars of great size and beauty.

The wood is light, close-grained, smooth, and compact, and possessed of great durability. The agreeable and permanent odor recommends it for certain uses, as that of making pencils and the bottoms of small boxes and drawers, the aroma making it a safeguard against insects. The sap-wood is white, but

[1] *Bigelow's Florula*, 2d edition, p. 370. This disposition to the ternate arrangement and acicular shape of the leaves is very common in this tree, and, with its tendency to spread near the ground, shows its near relationship to the common juniper, a species of the same genus.

[2] The necks of these bottle-shaped bodies, which are in fact only openings to the naked ovary, have till recently been mistaken for pistils.

the heart-wood of a beautiful red, whence is derived its name. It is much used to make posts, which last many years. It is also used in the manufacture of pails and tubs.

The timber is highly valued by ship-builders, boat-builders, and carpenters, and by cabinet-makers, and turners. Dr. Elliott makes an observation in regard to the trees as found growing in the Southern States, which holds true in several parts of New England. "Those which grow along the sea-coast, with their roots partially immersed in salt water, though smaller in their dimensions, are much more durable than those which inhabit the forests. Often when surrounded and finally destroyed by the encroachments of the salt water, their bodies remain in the marshes for an indefinite period, the roosting-places of vultures and of sea birds, become incrusted with pulverulent lichens, and seem to moulder away like rocks, rather than decay like a vegetable product."[1]

Dr. Bigelow[2] expresses a doubt as to the essential difference between our red cedar and the savin of Europe, whose name it often bears; and Sir William J. Hooker refers both, without hesitation, to the same species. The medicinal properties of

[1] *Botany of South Carolina and Georgia*, II., 717. I subjoin the following excellent remarks, from the Arator, as quoted in the "New England Farmer," VIII., 381, upon the use of the red cedar for the purpose of a hedge: —

"The cedar is peculiarly fitted for the purpose of live fences. It throws out boughs near the ground, pliant and capable of being woven into any form. They gradually, however, become stiff. Clipping will make cedar hedges extremely thick. No animal will injure them by browsing. Manured and cultivated, they come rapidly to perfection. The plants are frequently to be found in great abundance, without the trouble of raising them. As an evergreen, they are preferable to deciduous plants; and they live better than any young trees I have ever tried." They should be planted with a sod taken up of sufficient size to prevent injury to the roots, between December and the middle of April, on each side of a fence, the plants and rows being each two feet apart, and each plant in one row opposite the centre of the interval between two successive plants in the other row. "They should be topped at a foot high, and not suffered to gain more than three or four inches yearly in height, such boughs excepted as can be worked into the fence at the ground. Of these, great use may be made towards thickening the hedge, by bending them to the ground, and covering them well with earth in the middle, leaving them growing to the stem, and their extremities exposed. Thus they invariably take root and fill up gaps." — See Arator for more particulars as to their management, or "New England Farmer," as above.

[2] *Med. Bot.* III., 50.

both are the same; a decoction of the leaves having a stimulating effect, when used internally, in cases of rheumatism; and serving to continue the discharge from blisters, when used in the composition of a cerate for that purpose. The Bask shirs, a people of Russia between the Volga and the Oural, use a fumigation of savin for diseases of children, and attribute to its branches, hung at their doors, great virtue against witches.

From the exposed situations in which the red cedar grows, it often has to assume fantastic shapes. On the Jerusalem road at Cohasset, which leads along the top of a high sea-wall for some distance, exposed to the winds from the sea, is a tree which measured 5 feet 3 inches in circumference at two feet from the ground, and 4 feet 3 inches at five feet. The trunk is much bent, and all the branches violently twisted landward by the north-east wind, which pours in upon it from between two hills. The smooth bark is nearly covered with parmelias and other lichens.

Another, near the same place, lies prostrate on the rock from beneath which it springs. It has a circumference of 5 feet 3 inches as near the root as it can be measured, and 6 feet 8 inches at the largest part free of branches. These, numerous, crowded, and matted, bend down, like a pent-house, over the side of the rock. Others are seen on the same road, as if crouching behind walls; rising higher and higher as they recede from the walls, and forming protected, sunny spots for sheep to lie in.

This tree, of which there are many varieties, is found, in America, from the Saskatchawan, in Canada, in latitude 54°, as far as Georgia, Florida, Louisiana, the Bermudas, and Barbadoes Islands, around the Gulf of Mexico beyond St. Barnard's Bay, and through the Western States to the Rocky Mountains. It abounds in Europe and northern Asia, as far as the Crimea and the Oural, having thus a geographical range equal, perhaps superior, to any other tree known.

On the branches of the red cedar are often found excrescences, which, when fresh, are of a tough, fleshy consistency, enclosed in a reddish brown bark. On drying, they become of a woody texture. On the last day of June, a mild, rainy day, these were found, everywhere, enveloped by an orange-colored substance, in threads an inch or more long and one or two lines thick, gelatinous, of little consistency, and full of cells, each thread issuing from a circular or polygonal depression. On the following day, they were all beginning to dry up, and in a few days scarcely a trace of the gelatinous substance remained.

These cedar apples, as they are called, are commonly supposed to be produced by the action of some insect. They are, however, found to have quite a different origin. They make their appearance, according to Schweinitz, from whom this account is obtained, on the most delicate branches of the cedar, of the size of the head of a pin, and gradually increase to the diameter of one or two inches, still traversed by the unaltered branch. Whilst fresh and young, their substance is like that of an unripe apple, and of a whitish-green color within. This green tint soon changes to a tawny orange, and a few whitish fibres are observed radiating and branching from the base. They are covered with a bark of a brown-purplish lilac color, which is juiceless, like the peel of an apple. The whole surface is dotted with small polygonal, usually pentagonal, depressions, which are at first plane, afterwards slightly projecting in the centre. These projecting centres at last burst, and there issue forth from each, in moist weather, slender, gelatinous, strap-like "*sporidóchia*, about an inch in length, of the most beautiful orange color, adorning, in the course of a single spring night, the whole tree, as it were, with the richest crop of ripe oranges. If wet weather continues for many days, it remains in this state till the ligules melt away. Under the influence of the sun, however, they soon dry up, and never revive." This gelatinous substance is

composed of the lengthened sporidia, spore-vessels or seed-vessels, of a minute fungus, called by Schweinitz *Podisòma mácropus.* Dr. J. Wyman discovered one of these fungi so constantly near the lengthened acerose leaves, mentioned above, that he conceived there must be some connection between them, and that the fungus is, perhaps, the cause of the peculiarity in the length and shape of the leaf. I believe, however, that acerose leaves occur on perfectly healthy branches. The cedar apples continue to increase until the sporidóchia burst forth; but after this evolution has taken place, they cease to grow, and begin to become hard and dry. They last a year. When dry and old, they are of a spongy, fibrous texture, finally almost woody, as if formed of fibres radiating from the base.[1] On each of the junipers of Britain a similar fungus is found.

Sp. 2. The Juniper. *J. communis.* L.

Figured in Dr. Bigelow's Medical Botany; III., Plate 44.

The stem of the juniper is always completely prostrate upon the surface of the earth, or sometimes just beneath, with the branches spreading in every direction, rooting, and forming large beds. It is covered with a soft, reddish, scaly bark. The extremities of the branches are slightly ascending. The branchlets are very short and horizontal, or curved downwards, with a yellowish green bark which afterwards turns brown, and with long, rounded protuberances between the leaves. The leaves are in whorls of three, short, linear, sessile, rigid, curved at base, ending in a sharp point or bristle, concave towards the extremity of the branch, bright green on one side, and on the other, which, if the branch were erect, would be the upper side, white or glaucous along the middle. The

[1] See a communication from Dr. J. Wyman, in the forty-second number of the London "Journal of Botany," with additional remarks by the Rev. M. J. Berkeley.

barren and fertile flowers are on different plants. The barren are in short, solitary aments, situated in the axil of the leaves, made up of three or four whorls of scales, and set round at base with one or two whorls of very minute sharp leaves. Each scale is shield-like, rounded on one side, and pointed on the other, and protects about four anthers. The fertile flowers are also axillary, on a stout stalk invested with numerous minute, pointed scales, in four rows. Each flower consists of three fleshy scales, adhering at base, and separate only at the triangular points, within which are three bottle-shaped bodies containing each a germ. The fruit is a roundish, flattened berry, of a dark purple color, formed of the enlarged fleshy scales, whose points are marked by three slight prominences, separated by as many lines meeting at a common centre. Each berry contains three stony nuts, enveloped in a mealy substance nearly destitute of taste.

The juniper seldom rises more than a foot or two from the ground, but spreads extensively in every direction, sometimes covering several acres of the surface of dry rocky hills, and giving great trouble to the cultivator, as it is very difficult to extirpate. It is commonly destroyed by burning, and little use is made of the wood.

In Europe, where there are several varieties, one of which exactly resembles ours, the wood is much valued for its aromatic odor and its beauty, it being finely veined, of a yellowish brown color, and taking a high polish. It is used for walking-sticks, and for various small articles of the turner. "It makes excellent fuel, and is used in Scotland and Sweden for smoking hams. The bark is made by the Laplanders into ropes." The berries are principally used in making gin, which is a spirit obtained by distilling grain, flavored by an infusion of these berries. The berries are also used in medicine. When distilled, they yield a large quantity of pungent, volatile oil, of the peculiar flavor which is perceived in gin. In this oil the medicinal properties of the berries are supposed to

reside.[1] They have decided diuretic virtues, on which account they have been long and extensively employed in dropsical affections and diseases of the kidneys.

SECTION THIRD.

I. 8. The Yews. *Taxus*. L. Order *Taxaceæ* of Lindley.

By some authors, the yews, with several associated genera, have been separated from the other evergreens, and made to form a distinct family. They are distinguished by their fruits not being collected in cones, but each ovule growing singly, unprotected by hardened scales; so that the mature fruit has no resemblance to those of the true pines.

They are natives of temperate climates in all the quarters of the globe, and are occasionally found in hot latitudes; but are nowhere common. They are resinous, like the true pines, and have similar properties. The wood of the European yew is famous for its toughness; and, before the invention of fire-arms, was highly valued as the best material for bows, according to Spenser's descriptive line, —

> "The eugh obedient to the bender's will;"

and the name *taxus* is supposed to be derived from the Greek name for bow, *toxon* (*Τόξον*). The English name is the Saxon Iw, or Eow, hardly changed.

The European yew, of which ours is considered a variety, is remarkable for the hardness, weight, and extreme durability of its wood, which is red, and beautifully veined and knotted, and valued by the turner and cabinet-maker. It is a very long-lived tree, though of slower growth and greater durability than any other European tree; and it is one of those trees which best support the opinion of physiologists that exogenous trees are, by their nature, of indefinite growth; that they never die except by a violent death. A yew in Braburne

[1] Bigelow, *Med. Bot.*, III. 35.

churchyard, in Kent, was nearly 20 feet in diameter; and there is one in the woods of Cliefden, "called the Hedron yew, still in health and vigorous, which measures 27 feet in diameter."[1] The leaves of the yew are poisonous to cows and horses, though eaten with impunity by many other animals.

The Yew. Ground Hemlock. *Taxus Canadensis.* Willdenow.

The European variety figured in Loudon; Arboretum, VIII., Plate 293, and on pages 2074, 5, 7, 8, 9; and by Strutt, in Sylva Britannica.

In various parts of the western counties of Massachusetts, occurs a humble, almost prostrate evergreen, conspicuous for the rich and deep green of its foliage. It is the American yew. The road which leads from Pittsfield to Williamstown, after following up the valley of the Housatonic to its extremity, and crossing a low ridge of hills which supply some of its upper streams, descends the northern declivity and enters the valley of the Hoosic, with the magnificent Green Mountain range on the right and the Hoosic Mountains on the left. Every traveller will remember a deep gorge, where he passes for some distance under the shade of lofty trees, the rock-maple, the white and the yellow birch, and the hemlock, by the side of that wild and noisy stream, not yet visible. On emerging, and getting a sight of the river and its banks, he will perhaps remember, — if he is a lover of trees he cannot forget, — on the right bank, at the very foot of the mountain along which the stream runs, and shaded from the morning's sun by the trees which clothe its side, a mass or long bed of the most vivid and delicious green. The American yew grows there in great luxuriance. The traveller will be well rewarded for picking his way across the rocky river to examine it. It delights in such scenes, and perhaps nowhere flourishes in greater beauty than on that spot.

[1] Burnett, *Outlines*, I., 506.

The stem of the American yew trails on the ground, or just beneath the surface, to the distance of 6 or 8 feet. Beneath the surface, it is covered with a smooth, dark purple bark; where it protrudes above, it takes a grayish brown color. The terminal stems are slightly ascending; irregularly branched with crooked branches. The recent green shoots are very small and slender, with two slightly projecting ridges below the base of each leaf. The leaves arrange themselves in two rows; they are close set, half an inch long, linear, flattened, rounded at the base, and very pointed at the extremity, with the mid-rib slightly projecting on both surfaces. They are supported on short, green, hair-like footstalks.

The fruit is a kind of berry, of a rich scarlet color, formed of the fleshy calyx, embracing the dark-colored, oval nut. When half grown and green, it has a striking resemblance to an acorn.

For the sake of the very rich green of the yew, it might be cultivated beneath other trees, — its natural habit, to take off the bareness of the surface of the ground; especially under evergreens planted near a dwelling-house.

The American yew is often called ground hemlock. It is found at Otis, and in various other places along the Green Mountains. A vigorous stock of it may be seen at the Cambridge Botanic Garden.

The wood of the yew is of a yellowish-brown color, very heavy, tough, and elastic. The Indians often made their bows of it, —

"Their bows of double fatal yew."

This tree is found, prostrate, in Newfoundland, on Lake Huron, in Canada as far as the Saskatchawan. On the banks of the Columbia, Mr. Douglas assures us, it attains a size equal to that of the yew of Europe.[1]

[1] Hooker, *Flor. Bot. Am.* II., 167.

CHAPTER II.

AMENTACEOUS PLANTS. *AMENTACEÆ.* Jussieu.

The characteristic of this great division of plants is the arrangement of the flowers, of one or both sexes, in aments or catkins. It consists almost entirely of trees, many of them of the largest size, with a watery juice, or sap, and simple, or compound, alternate leaves, which fall at the approach of winter, and are reproduced after, or sometimes with, the flowers of the succeeding season. In some parts of Germany they are called summer-green, to distinguish them from evergreen. This seems a better name than the Latin, deciduous. The leaves have a mid-rib extending from one extremity to the other, and accompanied by small, leaf-like appendages, called stipules, on each side of the footstalk: which expand with them, apparently for their protection, and soon fall off; or, in a few instances, remain as long as the leaves. The two sexes are in distinct flowers, sometimes on the same, sometimes on different, trees. The male flowers are disposed in aments, which are made up of simple, stamen-bearing scales, or of cup-shaped leaves within or by the scales, containing the stamens. The female flowers are in aments, or are bud-like, or in fascicles. The wood is remarkable for its economical value, sometimes for its strength and durability; the bark, for its thickness, and for the abundance of the astringent principle of tannin which it contains.

Eight families, some of them of the greatest importance, belong to this division, — the Oak, the Hornbeam, the Walnut, the Birch, the Gale, the Plane, the Willow, and the Mulberry.

FAMILY II. THE OAK FAMILY. *CUPULIFERÆ.* Richard.

The oak family, the glory of the woods, and the friend and nurse of our race in its infancy, yields to few others in its

importance to mankind. The oak, the chestnut, the beech, and the hazel are everywhere, throughout all temperate regions, known and valued. In northern regions they are abundant; and they occur, though not in great numbers, in the southern hemisphere. A few are found upon the mountains within the tropics, but are unknown in the valleys.

As now constituted, it is a strictly natural family. The trees which belong to it are remarkable for their thick and rugged bark, and for the great abundance of the principle of tannin which it contains. They have large and strong roots, penetrating very deep, or extending very far, horizontally, beneath the surface, and sometimes, as in the case of the oak, both. The trunks are distinguished for their massiveness, and for the weight, strength, and, in most cases, the durability of their wood, and its preëminent importance in the arts. Their branches are long and irregular, and form a broad head of greater depth than belongs to the trees of any other family.

The buds are fitted for a climate with severe winters, the plaited or folded leaves being covered by imbricate, external scales, and often still further protected by a separate, downy scale, surrounding each separate leaf. The leaves are plane, and alternate, and usually supported by a footstalk, at the base of which are two slender leaflets, or stipules, which, for the most part, fall off as the leaf expands.

The fruit is valuable as food to man and the animals dependent on him. The fruits of the chestnut and hazel have been long cultivated on the Eastern continent, and much improved in size and quality. All are doubtless susceptible of it; but the life of these trees is so long in comparison with the duration of man, that experiments for this purpose must be carried on by successive generations.

This family includes trees and shrubs whose male and female flowers are separate, but on the same trunk. The male flowers, which appear early in the spring, are in long tassels called aments, or catkins, made up of a great number

of separate, cup-shaped, jagged scales, or membranous leaves, to the base or side of which, beneath or within, are attached the stamens, from five to twenty in number. The female flowers are usually bud-shaped. The ovaries, or seed-vessels are seated within a leathery cup, or involucre, are surrounded by an irregularly toothed calyx, and tipped with several stigmas. They contain one or several ovules, only one of which comes to maturity. The fruit is a bony or leathery, one-celled nut, partially or entirely enclosed in a cup. It contains one, two, or three pendulous seeds. The embryo is large, the cotyledons being the halves of the fleshy fruit. The radicle, or future root, is minute, situated at the top of the nut, and, in germination, is the first to make its appearance.[1]

The genera found in Massachusetts, are the oak, the chestnut, the hazel, and the beech.

II. 1. The Oak. *Quercus.* L.

"The Unwedgeable and Gnarled Oak."

By the Pelasgians, who, before the Greeks, occupied the land afterwards so illustrious for the arts and civilization of its inhabitants, and by the fathers of our Celtic ancestors, the oak was invested with a sacred character. In the oak woods, which gave him shelter and food, the Pelasgian believed there dwelt a deity, whom, in the awful solitude, he feared and worshipped. There were never wanting some to avail themselves of this superstition, and from the oak-trees of Dodona came an oracular voice which was listened to with a faith which accomplished its predictions. Still more sacred was the oak to the inhabitants of Britain and Gaul under the Druids.[2] The oak groves were their temples, and the mistle-

[1] The cup of the acorn is an involucre, formed by the growing together of a great number of little bracts; and the acorn is a fruit formed by the adhesion of an ovary to the calyx. One of the ovules increases rapidly after its fecundation, and renders the others abortive, either by attracting the sap, or by obliterating the threads of the pistillate cord.

[2] The name "druid" is supposed to be derived from a Celtic word, *drys*, which like the corresponding word *drus* (δρῦς), in the Greek, signifies *oak*.

toe which grew on the oak, an object of still greater veneration, was the wand of the druid. This, like every other superstition, must have had its origin in reason. And for what better foundation need we look, than the majesty, the durableness, the beauty, and the many useful properties of the oak?

Among the earliest inhabitants of Europe, with whom most of the fruits now used were not indigenous, the acorn was an important article of food.[1] Even now, the fruit of some species of oak is not considered unpleasant; and in the Morea and in Asia Minor, acorns are sold as food at the present day. The elder Michaux says[2] that he, as well as the naturalist Olivier, has verified this fact; and he reports that, at Bagdad, he ate excellent acorns as large and long as one's finger, the production of Mesopotamia and Curdistan. He also ate with relish the acorns of Spain, where, indeed, they are constantly eaten, as chestnuts or walnuts are here. There are probably few persons who have spent their childhood in any country town in New England, who have not found the acorns of the white oak, especially when roasted, a tolerably pleasant substitute for inacessible walnuts and chestnuts.

[1] The Greek and Latin words which we translate acorn, comprehended many kinds of fruit which are still considered agreeable food. The Arabs are said to give the name *tamar* to the fruit of the date-tree, and, when they wish to designate any other fruit, they add a specific name to this. Thus, the tamarind is the *Tamar-Hendi*, or date of India. So the Greek word *balanos* (Βάλανος) signified not only *acorn*, but *date*, *chestnut*, *beech-mast*, and several other fruits; and the persons employed to gather acorns were called *balanistæ* (Βαλανίσται), as well as those who gathered dates. The Latins used the word *glans*, a word of the same origin, much in the same manner. Alone, it signified the fruit of several kinds of oak. The date was called *glans Phœnicea;* the chestnut, *glans Sardinia;* the walnut, *glans Jovis*, or *Juglans*. In a similar manner is the word *gland* used among the French, who call the fruit of the oak, the beech, or the chestnut tree, *gland de Chêne, de Hêtre, de Chataignier*. And the word "acorn" in our own language seems to have come from the generic word corn, kernel, — united to aac, — the old name of oak. We may then safely presume that those Arcadian acorn-eaters (Βαλανηφάγοι), whom Plutarch reports to have been held invincible, because they made their principal food of acorns, did not always confine themselves to the dry and bitter nuts that we so call, but indulged a reasonable preference for the dates, chestnuts, and walnuts, included by them under the same name, and which even we sometimes suffer to make their appearance in an after course.

[2] *Histoire des Chênes*, p. 3.

ENGLISH OAK. *Quercus pedunculata.*

But if we sometimes reject the fruit, there are many other animals, not so fastidious. The oak is found growing naturally in all parts of the northern temperate zone, in Europe, Asia, America, and the northern parts of Africa; and, in all, contributes to the subsistence of a great variety of animals. In Europe, the stag, the roe-buck, and the wild boar winter upon its fruit. In Asia, pheasants and the wood-pigeon share it with animals of the deer kind. In our own native forests, the bear, the racoon, the squirrel, the wild pigeon, and the wild turkey, delight in various kinds of acorn; and swine, hardly less wild, fatten upon them.

In England, whose oak forests are now one of the sources of national wealth and naval supremacy, the tree was once prized only for the acorns, which were the chief support of those large herds of swine, whose flesh formed so considerable a part of the food of the Saxons. "Woods of old," says Burnett,[1] "were valued according to the number of hogs they could fatten; and so rigidly were the forest lands surveyed, that, in ancient records, such as the Doomes-day Book, woods are mentioned of a 'single hog.' The right of feeding hogs in woods, called *Pannage*, formed, some centuries ago, one of the most valuable kinds of property. With this right monasteries were endowed, and it often constituted the dowry of the daughters of the Saxon kings."

The oak is peculiarly subject to attacks of insects, which cause a great many varieties of galls; some kind being found on almost every part of the tree. These were once supposed to be the fruit of the tree. The most important is that known in commerce as the gallnut, and imported in large quantities into this and other countries from Aleppo, and other ports in the Levant. This is produced by the puncture of an insect called by Olivier, in his travels, *Diplolepis gallæ tinctoriæ*. which deposits an egg in each puncture, which immediately causes a swelling about the size of a walnut. The oak, on

[1] *Outlines*, 532.

which this takes place, is a small, shrubby species, called the *Q. infectoria*, common in all parts of Asia Minor and Syria, and valuable only for the gallnuts. Oak galls are among the most powerful vegetable astringents known, and form the basis of many styptics and astringent medicines. An infusion of them is said to be the best antidote for an over-dose of ipecacuanha.[1]

An insect found on a species of oak growing in the Levant, called *Quercus coccifera*, was for many ages used for the purpose of communicating crimson and scarlet colors. This continued to be the case until its place was taken by cochineal, the product of another similar insect, found on a species of cactus which is a native of Mexico.

As growing in New England, none of the forest trees have more numerous enemies of the insect race than the oaks. Their leaves are fed on by the slug-caterpillar (*Limacòdes*);[2] and by the caterpillar of the hag-moth (*Limacòdes pithècium*);[3] they are rolled up and destroyed by the leaf-rollers (*Tórtrices*),[4] and devoured by the scarred *Melolóntha* (*Melolóntha variolòsa*),[5] a beautiful beetle of a light brown color. The juices of the small twigs are sucked by the white-lined tree-hopper (*Membràcis univittàta*).[6] Their leaves are sometimes stripped by the tent-caterpillar (*Clísiocampa sylvática*);[7] by those of *Petàsia ministra*;[8] by those from which proceed the beautiful *Lùna Polyphèmus* moths;[9] by the tawny caterpillar of the large *Cératocampa imperiàlis*;[10] by the stinging caterpillar of the rare *Satúrnia Maia*;[11] and more extensively than by any other, by the oak caterpillar (*Dryocampa*).[12]

[1] BURNETT, *Outlines*, 535. Galls contain a peculiar astringent principle, called gallic acid, which strikes a deep purple color, gradually becoming black with the soluble salts of iron. This property renders them a valuable dye-stuff. Hence their request with dyers. They also form the basis of common black ink.

[2] *Harris's Report on Insects*, p. 419. [3] Ibid. p. 421. [4] Ibid. p. 347.

[5] Ibid. p. 33. [6] Ibid. p. 223. [7] Ibid. p. 375. [8] *Drury*, II., p. 28.

[9] Dr. Harris is of opinion that the strong silk, forming the large cocoons of these insects, might be substituted for that of the common silk-worm.

[10] *Drury*, I., p. 17; Plate IX., 1 and 2. [11] *Harris*, p. 396. [12] Ibid. p. 405.

ENGLISH OAK. *Quercus pedunculata.*

The oak-pruner (*Elaphídion putàtor*),[1] a long-horned beetle of a dull-brown color, lays its egg in the axil of a leaf, or of a small twig, near the extremity of a branch. The grub, when hatched, penetrates to the pith, and then continues its course towards the body of the tree, devouring the pith, and forming a cylindrical burrow several inches in length. It ends by severing the wood of the branch, leaving it to be broken off and precipitated to the ground by the autumnal winds. By this untimely pruning, the ground is often strown with branches, some of them an inch in diameter and five or six feet in length. If these are collected in autumn and burnt before the ensuing spring, the development of the beetles is prevented, and future evil guarded against.

A more dangerous enemy is fortunately of much more rare occurrence. The oak woods in some parts of the Old Colony are, at distant intervals, alarmed by the shrill, discordant rattle of the seventeen-year *Cicàda*, or locust.[2] They sometimes come out of the ground in such multitudes as, by their weight, to bend and even break the limbs of the trees. Their long subterranean residence has sufficed for the other ends of existence: they come to the light only to propagate and die. Their eggs are deposited in great numbers in the pith of the smaller branches of the oak, which are thus destroyed; are broken off by the winds or by their own weight, and remain hanging by the bark, giving a gloomy appearance to the woods; or they fall with their withered foliage to the earth. This, if annually repeated, would be a fatal scourge. The long periods which intervene before the return to the surface of the succeeding generation, alone preserve the forests from entire destruction.

Still more fatal are the ravages of those insects which invade

[1] *Harris's Report*, p. 98.

[2] *Cicàda septéndecim. Harris's Report on Insects*, p. 141. See the passages here referred to, for a most interesting account of these insects. Though called locusts in this country, they are very different from the locusts of history, which are grasshoppers.

the trunks of the oak-trees. The larvæ of one of the Buprestian beetles (*Chrysobóthris femoràta*) [1] bore into the trunk of the white oak; those of the timber beetles (*Lyméxylon* [2] and *Hylecœtus*) [3] make long cylindrical burrows in the solid wood of the oak, while standing in health; grubs of the northern *Brenthus* (*Arrhenòdes septentrionàlis*) [4] make similar burrows in the trunk of trees which are beginning to decay, and especially in those that have been cut down, which are attacked during the first summer after they are felled; the larvæ of the gray-sided *Curculio* (*Pandeletèius hilàris*) [5] make their habitation in the trunk of the white oak; and the grubs of the horn-bug (*Lucànus caprèolus*) [6] live in the trunk and roots of old oaks, as well as in those of several other species of trees.

The white oak is liable to the attacks of an insect, which punctures the small branches and introduces an egg, which has such an effect upon the juices of the tree as to form upon the side of the branch a spherical gall of one fifth to one quarter of an inch in diameter. These are found single, or two or three together, near the extremities of the smaller branches. If cut open in winter, they expose a worm, or chrysalis, folded up within a bony case.

For an account of the modes that have been devised to prevent or remedy the mischief done by so many enemies, I must refer to the Report of Dr. Harris,[7] to whom I am indebted for almost the whole of what I have given above, and who has done more than all other persons in the investigation of the difficult subject of the habits and ravages of the insects of Massachusetts; more, indeed, by original observation, than has ever before been done, by any person, in any country or State whatever. Care and precaution may do something; but against many of these insects the unassisted efforts of men can accomplish very little. Most of the birds, probably

[1] *Harris's Report*, p. 50. [2] Ibid. pp. 57, 58. [3] Ibid. p. 59.
[4] Ibid. p. 68. [5] Ibid. p. 70. [6] Ibid. p. 45.
[7] See the excellent edition by C. L. Flint.

all of them, the smaller quadrupeds, and all the reptiles, come to our aid, and wage perpetual war upon the insect tribes. The woodpeckers and the creepers do what they can to keep the bark of trees free ; the fly-catchers take care of the leaves ; a single flock of wild pigeons will do more than an army of foresters against the large solitary caterpillars which infest the oak forests.

The bark of most species of oak contains the tannin principle. The cups of the Velani oak are used for dyeing, and for tanning. Both purposes are effected by the bark of our common black or yellow bark oak. The bark of a species of oak which grows in Spain, *Quercus suber*, furnishes the invaluable substance, cork, which is used, in the countries where it is produced, not only for the purposes to which we apply it, but also as a lining and a carpet, in brick or stone habitations.

The bark of most of our oaks is useful to the tanner, particularly that of the white oak, the chestnut oaks, and others of the same group.

Yet the great value of the oak, in all countries, is for its wood. It is applied to a greater variety of important purposes than that of any other tree. With the exception of the teak-tree, it forms the best ship timber known ; and, for this purpose, the white oak is, perhaps, equal to the English oak, and surpassed only by the live oak. It was used for the frames of buildings, in preference to any other timber, until it became too scarce and dear. For strength, hardness, toughness, and durability united, it is unsurpassed, although each of these properties, singly, is found in a greater degree in some other wood. It is almost indispensable in the manufacture of implements of husbandry, and in all kinds of wheel-work. It makes the most valuable tables and chairs, and it would be used by the joiner, on account of its superior beauty, for the finishing of houses, were it not for the property which shows its superiority, its hardness. When employed for ornamental uses, the wood should be cut obliquely, to exhibit the reddish

silver grain. As an ornament to the landscape, or as a single object, no other tree is to be compared with it, in every period of its growth, for picturesqueness, majesty, and inexhaustible variety of beauty.

The main root of the oak, where the soil is favorable, descends to a great depth compared with its height, and it stretches to a distance horizontally, and that at a considerable depth, equal to the spread of the branches, thus taking a stronger hold of the earth than any other tree of the forest. Virgil says of it, —

> "Quantum vertice ad auras
> Ætherias, tantum radice in Tartara tendit."[1]

It does not often tower upwards to so magnificent a height as many other trees, but, when standing alone, it throws out its mighty arms with an air of force and grandeur which have made it everywhere to be considered the fittest emblem of strength and power of resistance. And deservedly: no tree in New England is to be compared to the oak in this respect, save the tupelo, and that in very rare instances. Nothing gave so vivid an impression of the irresistible force of the wind, in the great hurricane of 1815, as its laying prostrate even the oak. For, commonly, the oak braves the storm to the last, without yielding, better than any other tree. The limbs go out at a great angle, and stretch horizontally to a vast distance. This, with the great size of the limbs, is its striking character, and what gives it its peculiar appearance. They do not always go straight out, but crook and bend, to right and left, upwards and downwards, abruptly, or with a gentle sweep. The smaller branches preserve, in a considerable degree, the character of the limbs, and the spray varies with the species. So do the leaves, although, in the several species of the same group, there is a striking similarity; and I have gathered from the same stock, leaves which would seem

[1] "Whose roots descend
As low towards Pluto's realms, as high in air
Its massive branches rise."

to belong to several different species. Indeed, the nearly allied species are not to be distinguished by their leaves alone, viewed at any one season.

The oak is distinguished from all other trees by its acorn, for which the fruit of no other tree can be mistaken. The leaves of all the species are larger towards the extreme end; in some, they are more or less deeply lobed, with rounded or blunt lobes; in others, toothed, with large, round teeth; in others, deeply cut, with the divisions terminating in a long, bristle-like point, called a mucro. All the leaves are more or less downy while young, and many retain the down on the lower surface, when mature. The leaves of young plants and of sprouts from the stumps of trees are usually much more entire, as well as larger, than those on the mature tree. They come out late, and with them, or just before, the flowers. These differ less than the fruit, by which alone can some of the species be satisfactorily distinguished.

The stipules are membranaceous and perishing. The oak has but little medulla, but it continues in very old trees.

The flowers of both sexes are on one plant; the sterile disposed in long, slender, pendulous catkins, which are in groups; the fertile flowers, in a bud-like, scaly, cup. Rarely, fertile flowers are surmounted by male flowers, on a short spike mostly sterile. The ovary or seed-vessel of the fertile flower is divided into three compartments or cells, in each of which are two embryo seeds or ovules; but only one ovule in one of the cells comes to perfection; hence the fruit is a one-celled, one-seeded acorn, surrounded at base by the enlarged, scaly cup.

The acorns of the different species differ in being long and narrow, or short and round, pointed or blunt, on footstalks or sessile, and particularly in the scales of the cup in which the acorn is set. The acorns of some species come to maturity in a single season, but a considerable part of the New England species require two seasons to ripen. There is scarcely any seed in which the vitality is so transient, at least when the

acorn is preserved artificially. Few of them will germinate after having been kept a year. Most of the oaks — those particularly which belong to the white oak group — are shy bearers. Those allied to the red oak bear more freely. It is, however, uncommon to find any bearing abundantly two years in succession. Most of them, except the shrub oaks, must be trees of considerable height and age before they begin to bear. But they become more fruitful as they grow older, and continue bearing to the last.

The rate of growth of the oak is very different in the different species, and depends much, like that of every other tree, on the soil, and on the exposure. If raised from the acorn, it requires much shelter when young; and on all, except very rich soils, makes slow progress at first, although stumps of young and vigorous trees throw up shoots often of five or six feet in a single year. As it is slow in the early stages of its growth, it continues to make steady progress for many years, and requires one hundred or one hundred and fifty years to come to perfection.[1] From measurements upon a great number of trees recently felled, and from many specimens of the wood, of all sizes and from various soils, I believe that the average growth of the white oak is not far from two inches in diameter in ten years, after it has been growing thirty or forty years; the circles of growth, after that age, being about ten in an inch.[2] Before that age the growth is more rapid, but extremely various. An oak of thirty years may be eight inches in diameter, and forty feet high. At or below this age it is commonly considered most profitable to fell for fuel; and

[1] De Candolle found that the circles in very old oaks, cut in the forest of Fontainebleau, continued to increase to the thirtieth or fortieth year; from thirty, to fifty or sixty, diminished a little; between fifty and sixty, became nearly regular, and so continued to the end. Past sixty, the increase is eight to ten lines in diameter, in ten years; two or three inches when between twenty and thirty, — indicating a cutting every thirty years.

[2] I give here memoranda of some of the oldest of these trees. On one, I counted 125 rings of growth in 11½ inches; on another, 147 rings in 12½ inches; on the third, 150 rings in 21½ inches; on the fourth, 179 rings in 21 inches.

it doubtless is so when it is to be renewed from the stump. But an easy calculation shows, that, although its apparent growth after that age is less than before, the real growth of each individual tree is greater. In ten years more it will be ten inches in diameter. Two inches will have been added throughout the whole forty feet, though not much, probably, will have been added to the height. Now, as the growth must be estimated by the squares of the diameters, the solid wood in the lower part of the trunk will have increased in the proportion of 100 to 64. In the next ten years, it will increase in the proportion of 144 to 100; in the next ten, in that of 196 to 144; and in the next, in that of 256 to 196. The numbers after them will be 324, 400, 484. The successive additions, in periods of ten years, will be as the numbers 36, 44, 52, 60, 68, 76, 84, 92, 100. A tree of thirty years, therefore, in ten years, will increase 56 per cent.; in the next similar period, 68 per cent.; in the third, 79; in the fourth, 93; in the fifth, 106. That is, an oak of eighty years of age grows more in ten years than it did in the first thirty; and an oak of one hundred and thirty years, more than in the first forty. When, therefore, it is desirable to keep the growth for timber, the process of thinning may be continued with strict economy, as the increase of the thirty or forty trees left on the acre will counterbalance, in a great degree, the loss in numbers. Some acres, in every large forest, should be thus left, for the use of the ship-builder.

Those species of oak most analogous to our white oak, are known, in Europe, to continue to grow and flourish for centuries. There are oaks in Britain, which are believed to have been old trees at the time of William the Conqueror. Some are known, which are supposed to be one thousand years old.

The number of species of the oak known to botanists is very great. In 1823, the whole number was one hundred and thirty (Dictionnaire Classique d'Histoire Naturelle); since which time a considerable number has been added. Loudon

estimates them at present at one hundred and fifty. This number is probably overstated, as many that are considered species will doubtless be found to be varieties. Sprengel enumerates more than one hundred oaks, the larger part natives of this continent. The elder Michaux described twenty, the younger, twenty-six, as natives of North America. Pursh described thirty-four as belonging to North America. Nuttall, in 1817, mentioned thirty-two as belonging to North America. Eaton describes thirty-six as found north of the Gulf of Mexico. Beck, twenty-three, as belonging to the Northern and Middle States. I have found twelve in Massachusetts, growing in considerable numbers. I have probably overlooked several, but they must be stragglers. Two only are natives of Britain; eight of France (Flore Française), though the number is increased by some botanists to fourteen. De Candolle, in the "Prodromus," published in 1868, describes 281 oaks: of which 33 or 34 are found within the limits of the United States, 90 in Mexico and Central America, 21 in Europe, 2 in Africa, 28 in China and Japan, 60 in continental Asia, 26 in Java, 14 in Sumatra, 6 in Hong-Kong, 3 in Borneo, 1 in the Moluccas. Several others have since been found on the Pacific slope, within the United States.

The most natural arrangement of the American oaks, seems to be that adopted by the elder Michaux. He divided them into two sections, according to the character of the leaves: the first comprising those species whose leaves are destitute of flexible points or bristles; the second, those the segments of whose leaves are mucronate, or terminate in bristles. A very important difference is also observed in the length of time required for the blossom to bring its fruit to maturity. Most of the oaks of Europe blossom in the spring, and mature their fruit the same season; and this is the case with those of the American oaks which belong to the first section. In those included in the second, on the contrary, the fertile blos-

som makes its appearance in the axil of the leaves on the new shoot, is then fecundated, and remains a whole year without change. In the spring of the second year, after a new shoot has been produced, and new barren and fertile flowers have made their appearance, it begins to increase, and brings its fruit to maturity eighteen months after its first appearance. In this case, the fruit seems not to be axillary, as the leaves of the previous year, in whose axils it grew, have fallen.

Most of the trees which belong to the first section, possess greater value, on account of the excellent properties of their timber, than those of the second.

FIRST SECTION.

Leaves not mucronate; fruit supported on footstalks; fructification annual.

This includes the White Oak, the Swamp White Oak, the Chestnut Oak, the Rock Chestnut Oak, the Over Cup White Oak, the Post Oak, and the Little Chincapin Oak.

SECOND SECTION.

Leaves mucronate; fruit nearly sessile; fructification biennial.

Black Oak, Scarlet Oak, Red Oak, Pin Oak, and Little Bear Oak.

TABLE OF THE SPECIES.

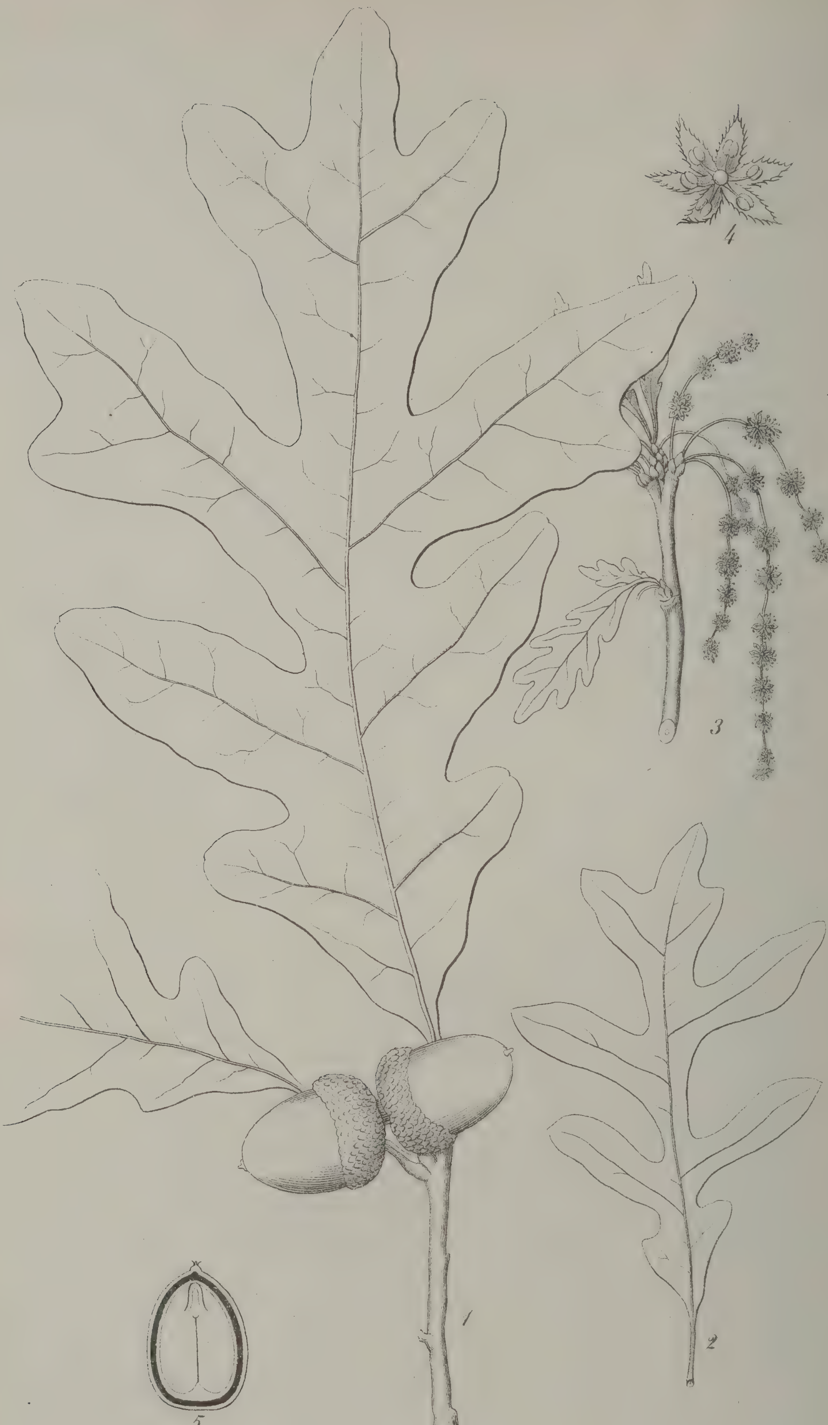
1. { Leaves not mucronate. 2.
   —— mucronate. 5.

2. { Leaves lobed. 3.
   —— toothed. 4.

3. { Leaves nearly regular, acorn cup warty. *White Oak.* 1st.
   —— deeply lobed, very irregular, cup fringed. *Over cup.* 2d.
   —— —— —— upper lobes dilated, star-like, very rough. *Post.* 3d.

4. { Leaves wedge-shaped at base, much larger towards the end, with one deep sinus on each side. *Swamp White.* 4th.
   Leaves nearly regular, long and narrow. *Chestnut.* 5th.
   —— larger towards the end, entire, rounded at the extremity. *Rock.* 6th.
   —— larger towards the end, waved or toothed; a shrub. *Chincapin.* 7th.

5. { —— deeply sinuate, downy beneath; bark yellow within, very bitter. *Black.* 8th.
   Leaves more deeply sinuate, smooth beneath; bark reddish within, less bitter. *Scarlet.* 9th.
   Leaves less deeply sinuate, lance-shaped; cup very broad, scales close. *Red.* 10th.
   Leaves deeply sinuate, all, as well as the acorn, smaller than in the preceding species. *Pin.* 11th.
   Leaves somewhat lyrate, or 4 or 6 sided; a shrub. *Bear.* 12th.



WHITE OAK. (*Quercus alba.*)

Sp. 1. The White Oak. *Quercus alba.* Linn.

Leaves and fruit figured in Michaux; Sylva, Plate 1; the tree, in Loudon's Arboretum; Plate 69. E.

In Audubon's Birds of America, Plate 107, the leaves are figured, with the Canada Jay, and in Plate 147; and in our Plates.

> Not a prince,
> In all that proud old world beyond the deep,
> E'er wore his crown as loftily as he
> Wears the green coronal of leaves with which
> Thy hand has graced him. — *Bryant's Forest Hymn.*

The white oak rises from many strong roots, which swell out, near the base, above the surface, and penetrate deep and to a great distance beneath. It is two to four or five feet in diameter. The perpendicular trunk, in most of the trees which are standing in our fields and pastures, is not long. In old forests, it sometimes reaches the height of sixty or eighty feet, and even more. Limbs very large, diverging, at a very large but not uniform angle, from a broad, gnarled, massive juncture. Some of them go out horizontally, variously contorted, much and variously branched. The higher limbs make a sharper angle. They all often make considerable bends, in any direction; upwards, downwards, or on either side. Spray of many twigs, at right angles, in all directions, miniatures of the larger limbs. The bark on the trunk is of a very light ash-color, whence it is universally known and always called the white oak. And it is the only oak which has but one name. The bark naturally breaks into small, irregular, four-sided plates, which often easily scale off. The leaves, on short petioles, are four to six inches long, and two or three wide. They are pubescent beneath when young, but smooth when old: the upper surface of a bright, shining green; the lower paler or glaucous, in substance almost coriaceous. They are always deeply divided into lobes, about three or four on each side, which are oblong, rounded, or

obtuse, rarely subdivided. The leaves differ very much, in different localities. Sometimes the lobes are almost linear, making skeleton leaves. Sometimes the leaves are perfectly and beautifully regular. These differences mark varieties which, when trees come to be as highly valued and as carefully studied here as they are in England, will receive names. I have met with many of these varieties which would be worth cultivating for their peculiar beauty. In autumn, the leaves turn to a pleasant purple or violet color, very different from that of most other leaves. Many of these remain on through the winter, making in this tree the nearest approach to the evergreen oaks of warmer climates. The buds are small, short, rounded, and invested with several indistinct scales. The male flowers are on a long and very slender thread, each cup containing from four to seven stamens.

The acorns vary much in size and sweetness, and somewhat in shape. They are usually about an inch long, ovoid, oblong, in a shallow, somewhat flattened, hemispherical cup, of a grayish color, rough externally, with roundish tubercles. They grow single or in pairs, on a footstalk, from half an inch to an inch long, fixed to the year's shoots.

The fruit is seldom abundant, not oftener, it is commonly thought, than once in seven years; and I have looked through an extensive forest of white oaks, at the season when the fruit was to be expected, without finding an acorn. The fruit is eagerly sought for by many wild animals, and is not unpleasant to the taste, especially when roasted.

Michaux says, that he found the white oak as far north as the latitude of 46° 20′; as far south as latitude 28° 11′, and towards the west to the country of the Illinois. We know that it extends much farther to the west. He thinks it more multiplied in the western parts of Virginia and Pennsylvania than in any other parts of the United States. Mr. Douglas considers Lake Winnipeg its northern limit, and says that it attains there a height of ten to twenty feet.

ASSABET WHITE OAK. *Quercus alba.*

AT STOWE.

It is found in every part of this State, although very rarely in the western, where its place is taken by the rock maple, and most abundantly, and of the largest size, in Essex County. It grows well on a great variety of soils, but best on a moderately high, moist, loamy soil; particularly in sheltered situations, as on the southern sides of hills. No tree is more affected by the wind in the early stages of its growth; and it everywhere seems to shrink from the sea breeze.

The wood of the white oak unites the properties of hardness, toughness, and durability, in a greater degree than any other native wood. It is of a reddish hue, and is very heavy, compact, and close-grained. The interval between the circles of growth is, however, porous, the pores sprinkled with brilliant, resinous-looking points. The plates of silver grain, radiating from the pith, are thicker and more remote from each other than in most woods, and are at very unequal distances. As in the other oaks, they are somewhat sinuous. They are not so thick as those of the live oak, but more so than those of the black. Its specific gravity, according to Bull, is to that of shellbark hickory as .855 to 1.

On account of its uses, the white oak is the most valuable of our trees. It is applied to almost every purpose. It furnishes the best ship-timber. It is preferred for the upper and lower floor timbers, for keel, kelson, stem, and stern posts and timbers, for lower deck beams, for out-board planks, and for clamps, or the thick stringers on the inside, on which the beams rest. By some it is preferred to locust for treenails.

Carriage and wagon builders use scarcely any thing else for the spokes of wheels. The carriage makers of Boston get it from the towns in the vicinity. It is also used for the fellies and axles, and sometimes for the hubs, of wheels (but not in preference to all other materials), and for the frames and runners of sleighs. The ribs, knees, gunwale, and ribbons, and the chalks and top chalks of whale-boats are of white oak. Many agricultural instruments are made of it; the mould-

boards and handles of ploughs, and often axe-helves; the body, frames, tongues, and axles of carts.

It is preferred to every other wood, except pitch pine, for pumps. It is used for the very best casks, — those intended to contain water, provisions, and all penetrating liquors; and for these purposes it is imported into Boston from Mobile, New Orleans, and other Southern ports. It makes the best hoops, with the exception, perhaps, of hickory; both which must be wrought while in a green state.

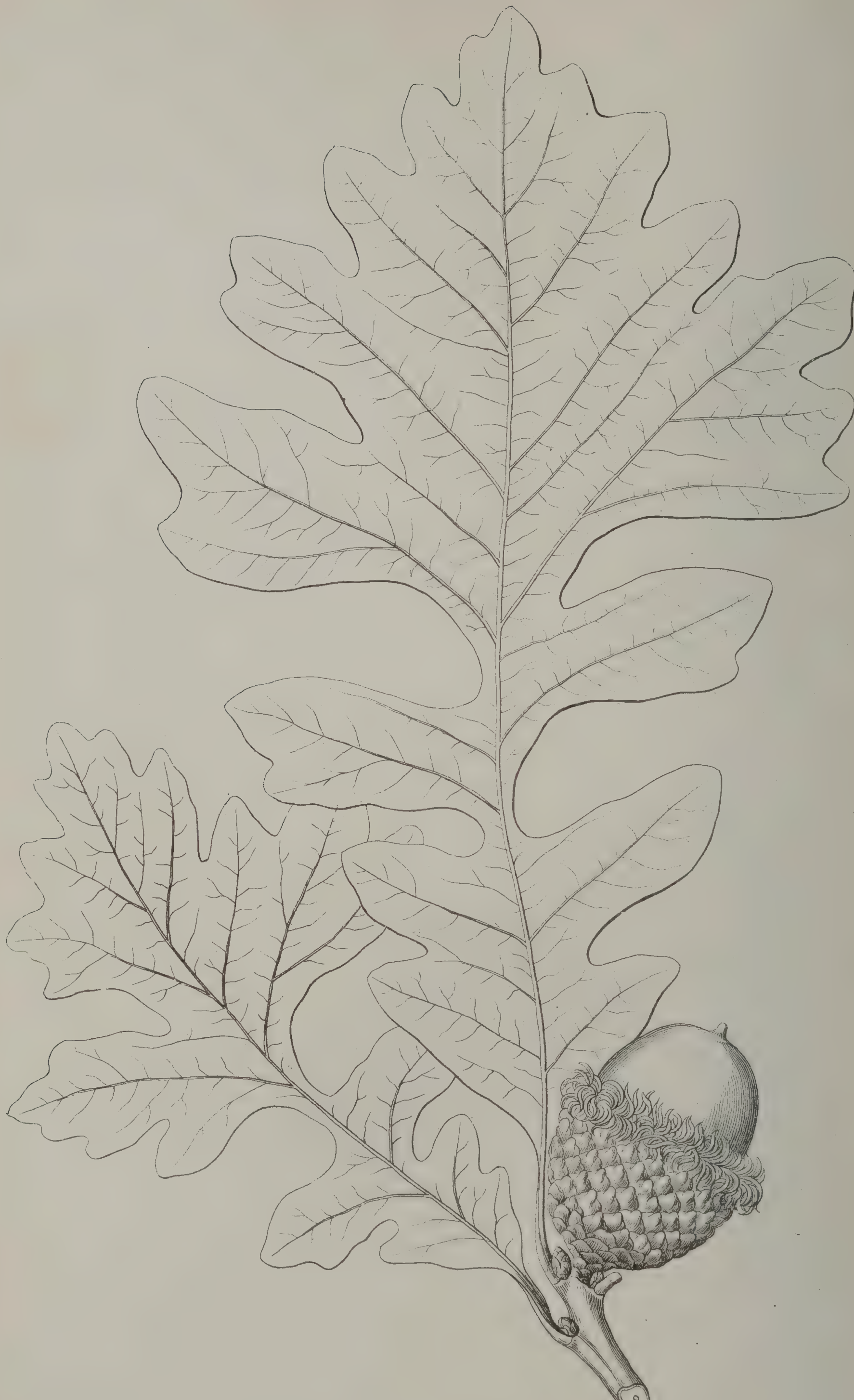
For the purpose of making baskets, the lower part of the trunk of young white oak trees is very much used, on account of its great elasticity and suppleness, and the evenness with which it may be divided into narrow strips or ribbons, when in that stage of growth. For this purpose, it is worth twenty dollars per cord. The wood of the young tree is also used for ox-bows, where hickory cannot be obtained, and even in some places in preference to it. It is often used for handspikes and levers, and all those numerous purposes in which strength, elasticity, and toughness are required.

The bark is valuable to the tanner. It is nearly like that of the European white oak, which is so highly prized in England and France that all the small branches are stripped whenever an oak is felled. In this respect, there is still a great want of economy in most parts of our country. The average value of this bark, near the sea-coast, is about eight dollars per cord.

The root of the white oak is seldom taken up, except for the purpose of making knees for naval architecture. But, judging from the great beauty which a section of these roots sometimes exhibits, they might with advantage be substituted for many of the foreign, imported woods, for ornamental purposes, as for the manufacture of chairs and tables. The great defects of the wood of white oak is its shrinking much and irregularly, which may, however, be obviated by thorough seasoning.

The value of white oak for charcoal is very considerable,

WHITE OAK. *Quercus alba.*



OVERCUP WHITE OAK. (Quercus Macrocarpa.)

being surpassed only by that made from the chestnut, the hickories, and the chestnut white oak. As fuel, it is quite as much prized as it deserves, making at best but a slow fire, and far inferior, for this purpose, to the hickories. Its great importance, as timber, and its increasing scarcity, will, however, prevent its being much used for either of these purposes.

What has been said of the oak as an ornamental tree, applies especially to the white oak. It is beautiful in every stage of its growth: at first, light, slender, delicate, and waving; at last, broad, massive, and grand, but always graceful. Let every one who has an opportunity, plant a white oak. When standing in a situation, where it is somewhat protected, and has room freely to expand its limbs, it will every year improve in beauty and magnificence, for a time equal to at least five of the generations of men: —

> "Multosque nepotes,
> Multa virum volvens durando sæcula vincet."

When standing together, the mixture of all the various species of the oak, will make a much more beautiful forest than any one alone.

The great value of this tree has caused the destruction of almost all trunks suitable for timber, so that it is rarely found of a large size. One which I measured in Greenfield, in 1838, was seventeen feet five inches just above the root, and fifteen feet three inches at three feet. A white oak standing nearly opposite Deacon Nurse's, in Bolton, measured, in 1840, nineteen feet just above the roots, and fourteen feet at three feet from the ground. It had a fine, fresh, broad head.

Sp. 2. The Overcup White Oak. *Q. macrocarpa.* Michaux.

Leaf and fruit figured in Michaux; Sylva, I., Plate 4. Leaf and fruit in our Plate.

This oak, as it occurs in Massachusetts, is a fine, erect tree, of medium height, much and irregularly branched, and clad

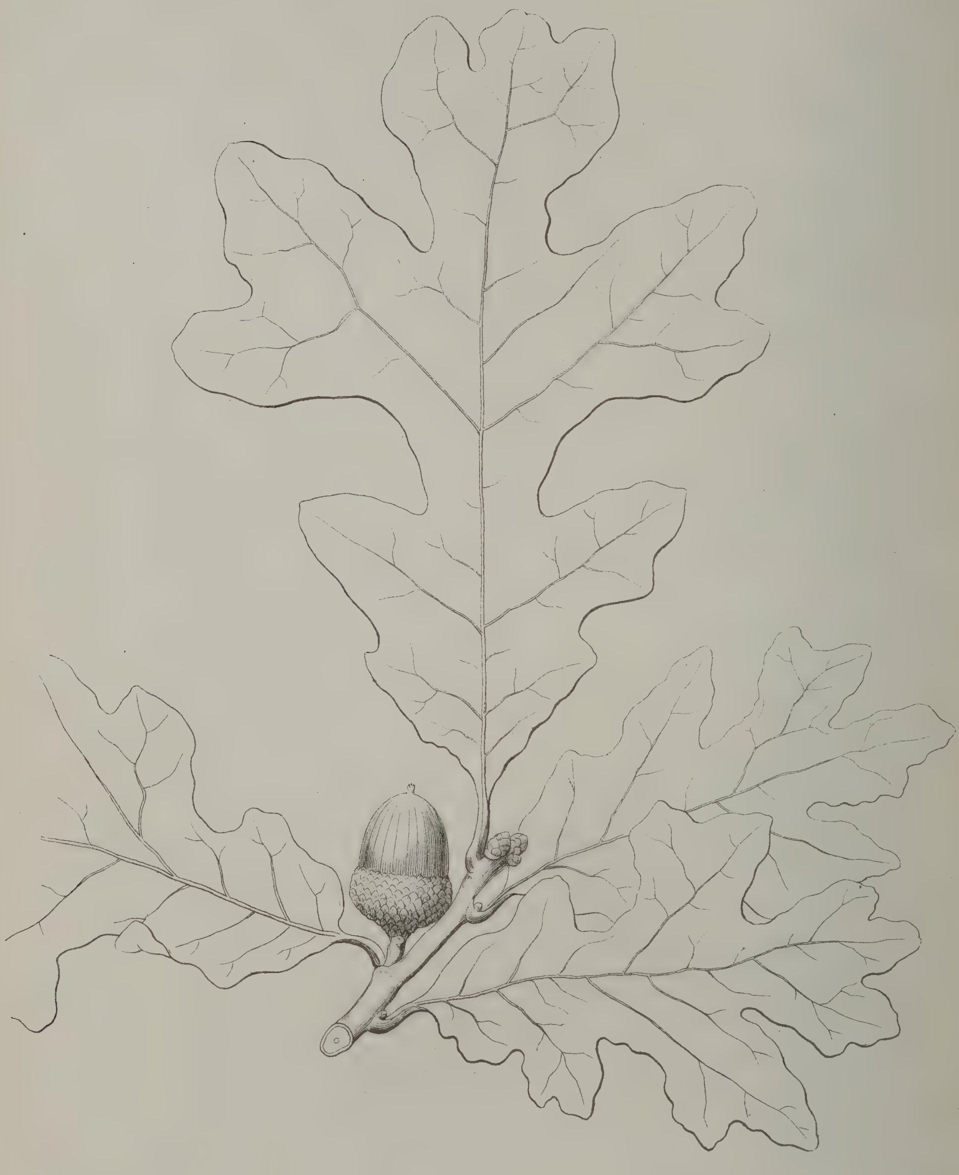
with a most luxuriant foliage. The lower branches are short, horizontal, and bushy; the upper ones tending upwards, but often bending, at sudden angles, in various directions. The aspect of the tree is much like that of the swamp white oak, but the branches are free from the loose bark which often deforms that species. The bark on the trunk is of an ashen color, intermediate between that of the white oak, and of the swamp white oak, less broken than either, with long, superficial ridges, or scales. The recent shoots are covered with a yellowish brown, somewhat downy, dotted bark, turning gray the second year, and soon after becoming rough.

The leaves are on short footstalks, pear-shaped in their general outline, very deeply and irregularly sinuate-lobed, with three, four, or five bays near or below the middle, which extend very nearly to the mid-rib; wedge-shaped or rounded below, usually much broader and more entire towards the extremity. They are smooth and of a dark green above; much lighter, cinereous or glaucous, at first downy, finally nearly smooth beneath; six or seven inches long, and three or four wide.

The buds are small, compressed, and conical. The acorns are very large, and enclosed, for more than half their length, in a cup covered with very prominent scales, and bordered by a conspicuous fringe of long, flexible threads. Michaux says that these threads do not appear when the tree is in the midst of a forest, or when the summers are not very warm.

This tree is found in Stockbridge, and the towns below it in Berkshire County, and in the neighboring county of Dutchess, in New York, particularly in Dover, on Ten Mile Creek, a tributary of the Housatonic. As Mr. Oakes has also found it in Vermont, it probably occurs in some of the intermediate towns. It has not previously been known to occur in Massachusetts. Michaux found it most abundant in Kentucky, Tennessee, and on the Missouri.

It is called pin oak, in Stockbridge and Sheffield, from its



ROUGH OAK. *Quercus stellata.*

use in making wooden pins or treenails, for which purpose it is preferred to every other material. The wood of this oak is very solid and stiff, and approaches in durability that of the white oak. It is said to be less elastic and tough than white oak, but more solid and smoother-grained. It is used for the axles, reaches, bolsters, and braces of wagons; for framing timbers, for sills, and for floors; and for all the other purposes for which the best oak wood is employed. As fuel, it is preferred to white oak.

The beauty of this tree, the abundance and luxuriance of its foliage, and the extraordinary size of its acorns, recommend it to the landscape gardener; the value of its wood, to the forester.

Sp. 3. Post Oak, or Rough Oak. *Quercus stellata.* Willdenow. *Q. obtusiloba.* Michaux.

Leaves and fruit figured in Michaux; Sylva, Plate 5; in Abbot's Insects of Georgia, I., Plate 47, and II., 77; also on our Plate.

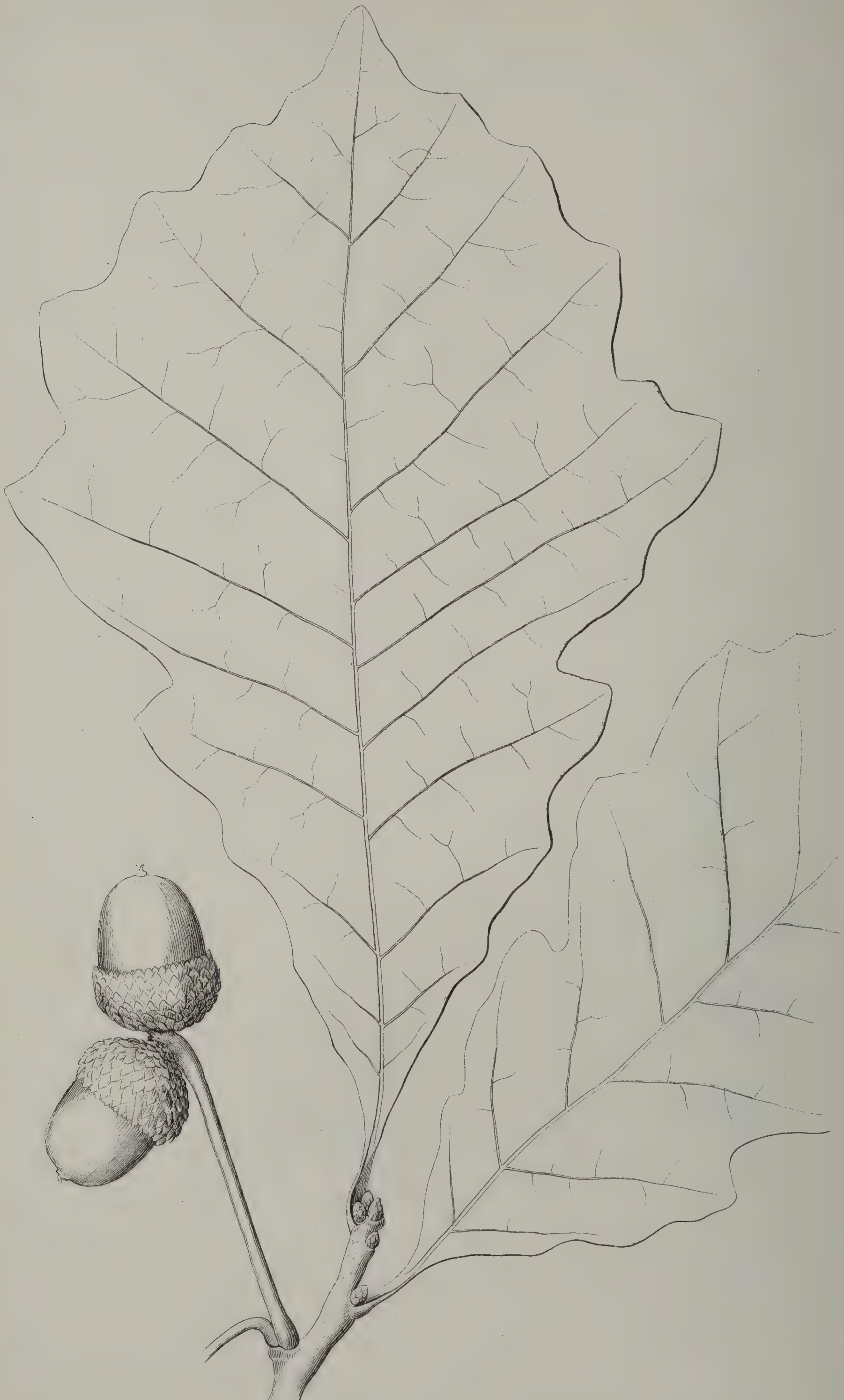
I have found this oak nowhere in Massachusetts, except on the Elizabeth Islands, where, particularly on Martha's Vineyard, it is very abundant, and is called the rough oak, from the roughness of its leaves. It is also found in Plymouth and Barnstable Counties. It resembles the white oak, but is distinguished at once by its mode of branching, by the density of its foliage, and by the stiffness and peculiar form of its rough leaves. It rarely grows above twenty-five or thirty feet high, and eighteen or twenty inches in diameter. The trunk is covered by a rough, hard, grayish-white bark, broken by deep crevices into oblong portions, usually scattered with whitish and black lichens. The branches are numerous, low, at right angles, and very crooked, and, being crowded near the base, give the appearance of the top of a tree whose trunk is under ground. The shoots of this year's growth are long, and covered with a whitish and downy bark. The leaf-stalks are very short. The

stiff, coriaceous leaf is divided, at one-third its length, by a deep sinus on each side; the upper portion is of three broad, obtuse, divergent lobes, often double. The upper surface is dark green, and very rough; the lower, whitish, softer, downy, the mid-rib and nerves turning to a rose color in autumn. The leaves have not unaptly been called stellate, the upper part resembling a star. They are close set, in large bunches or tufts, much more fleshy and close than those of the white oak, and giving greater fulness and depth to the foliage. The spray is larger and thicker. The acorns, nearly sessile or on very short footstalks, are set in a grayish, broad cup, invested by numerous, very smooth, close scales, and are small and sweet. They are single, or two, three, or four together.

In Camden, opposite Philadelphia, where I particularly observed this tree, it is a fine tree of fifty or sixty feet, bearing a broad, massive head, and casting a deep shade; and it would probably be so in Massachusetts, at a distance from the sea.

On Martha's Vineyard, where the tree never grows large, the wood is preferred to all others for fuel. It forms very valuable knees for ship-timber, but is rarely of sufficient size for other purposes. In the Southern States, it is called post oak, and is preferred to all other kinds of wood, on account of its durability, when used as posts. "Its timber is supposed, in strength and durability, to surpass that of any other species of the oak, except the live oak; and, therefore, is highly prized when it can be obtained sufficiently large to be used in the construction of vessels."—(*Elliott.*) Staves made of it are preferred to those of any other material.

Michaux had not found the post oak north of the Hudson, and supposed that its existence as far north as on the western bank of this river, opposite New York, was due only to the influence of the sea-breeze in tempering the severity of the cold. On the Vineyard, it nearly covers a promontory which projects eastwardly of Holmes' Hole into Buzzard's Bay. In the most exposed situations, it is very low and scraggy, form-



SWAMP WHITE OAK (*Quercus bicolor.*)

ing a sloping wall of close, crooked branches and trunks, towards the sea-breeze. Behind and under cover of this, it rises higher towards the centre of the island, but I think never exceeds thirty feet. In the same exposed situation, the other oaks, particularly the black, hardly exceed this in height; whilst, in the centre of this island, the latter becomes a very large and tall tree.

I think the post oak would grow readily in a sheltered situation, in any part of Massachusetts; but it probably would not reach a great height.

It abounds in the western and south-western States; and probably some of the timber imported thence under the name of white oak, with which it is often confounded, is the produce of this tree.

Sp. 4. The Swamp White Oak. *Quercus bicolor.* Willdenow.

Leaves and fruit figured in Michaux; Sylva, I., Plate 7; and in our Plate.

The swamp white oak is found in great numbers in the low moist grounds in the vicinity of Boston, and in every county in the eastern section of the State; and it occurs as far north as York County, in Maine. It is distinguished at all seasons by its nearly entire, wedge-shaped leaves, and by its white bark, rough, with large, loose flakes or scales, and its numerous and intricate branches. These begin low down on the trunk, but are seldom of great height. The bark on the smaller, recent branches, is of a light grayish green.

In warm and sheltered situations, it is a neat and beautiful tree. When too much exposed to the east or north wind, it shows the effect by its ragged appearance.

The leaves, when young, are very downy, with a whitish ferruginous down beneath, and of a reddish green above. When mature, they are on short footstalks, three to six or seven inches long, and two to four broad, acute at base, having

often a rather deep bay on each side just below the middle, and usually abruptly dilated towards the end, bordered by a waving line, forming from nine to thirteen large teeth, mostly obtuse, but sometimes ending in a callous point. The edge is slightly folded back, smooth, and of a pleasant green above, and covered beneath with a white, very soft down; nerves and larger veins prominent, and rust-colored. Below the large leaves are commonly found smaller ones, with four or five teeth, or perfectly entire. The leaves, in fading, become of a light leather yellow.

The buds are short, roundish, and obtuse. In May, the male blossoms appear in great numbers, on threads two or three inches long, from the base of the new shoots, or from lower buds, which produce them only. There are about four stamens in each flower. In the axil of the tender, just expanding leaves, the female blossom appears, single or in twos, on a footstalk of half or two-thirds of an inch in length.

The footstalk lengthens, late in the season, to two or three inches, and bears one or two very broad, roundish-ovate, pointed acorns, in deep, broad, hemispherical cups, rough, and sometimes ragged and mossy without, with the projecting points of the scales, from whose union the cup is formed.

The fruit is sweet, not abundant, but more so usually than that of the white oak.

There are many varieties of this tree, differing strikingly in the smoothness of the bark, in the shape of the leaves, sometimes narrow and somewhat deeply lobed, in the roughness of the acorn cup, and the character of the branches. They are not often handsome, usually offending the eye with the roughness and scaliness of the bark, and the scragginess of the branches. But there are exceptions; and some of the varieties are fine, shapely trees.

The wood of the swamp white oak is of a brownish color, heavy, compact, and fine-grained, and possesses great strength and elasticity. It approaches in value to that of the white

CHESTNUT OAK. (Quercus Castanea.

oak. By boat-builders it is sometimes preferred. It seems to have, in an inferior degree, the properties which distinguish that wood, and forms an excellent substitute. It has considerable toughness, so that hubs are sometimes made of it.

This tree grows to a large size. I have seen stumps which measured five feet and more in diameter. But I have not measured many large trees. One, a third part of a mile from the great elm, on the land of Mr. Jaquith, Newbury, growing in a wet, clayey soil, measured, in 1839, twelve feet and one inch in circumference, at four feet from the ground. In the Botanic Garden in Cambridge there is, in 1874, a fine tree, measuring nearly nine feet, at three feet from the ground.

Sp. 5. The Chestnut Oak. *Quercus castanea.* Muhlenberg.

Leaves and fruit figured in Michaux; Sylva, Plate 10, and in our Plate in this volume.

This graceful tree is distinguished from the rock chestnut oak, by its narrower leaves, more nearly resembling those of the chestnut tree, and having sharper teeth, and by its smaller fruit.

I have found only a few straggling individuals, and at first took them for varieties of the tree last mentioned. I was struck with their beauty; but I have been able to learn nothing in regard to the peculiar qualities of the wood as fuel, or as timber, or of the bark, as it is, wherever found, confounded with the rock chestnut oak, and, together with that, known by the name of chestnut oak. Several trees of this group are, in all the States where they grow, confounded with each other by the common people. And the elder Michaux, who viewed them with the discrimination of a botanist, and with a wealth of observation which could afford not to multiply species, considered them as varieties of the one species, *Prinus*. The younger Michaux makes this a distinct species, and points out some striking peculiarities. He says that the wood is of a

very yellow color; that it grows only in fertile valleys; and that its bark separates in sheets, like that of the swamp white oak. The texture of the wood also differs in having more numerous, and irregularly disposed, flakes of silver grain, than in any of the other oaks. Whoever has been in the habit of examining many trees and varieties of wood, will be willing to admit that these differences are not greater than we meet with in trees acknowledged to be of the same species. These trees must be raised, side by side, from seed, before we can be sure of their essential distinction.

The younger Michaux considered the banks of the Delaware as the north-eastern limit of this oak, which he found most abundant in some parts of Pennsylvania and Tennessee. I have found it growing about Mount Agamenticus, and, farther north, on the banks of the Saco River, in York County, Maine. In this State, I have found it in Lancaster, Sterling, Russell, and Middleborough.

Sp. 6. The Rock Chestnut Oak. *Quercus montana.* Willdenow.

Figured in Audubon's Birds, Plate 131; leaves and fruit figured in Abbot's Insects of Georgia, II., Plate 82; in Michaux; Sylva, Plate 9; and in this volume.

This oak is by no means frequent in the State, and where found, it is usually confined to small districts on rocky hills. It is called sometimes the rock oak, or, more frequently, the chestnut oak, and has great resemblance to the chestnut tree in its general appearance and mode of growth. I have found large forests of it in South Attleboro'; small patches in Middleboro', in Sterling, and Lancaster; larger ones in Erving's Grant, and that neighborhood; and detached clumps in various places in the hill country, on both sides of Connecticut River. It is found in New Hampshire and Vermont, and is abundant on the Alleghany Mountains.

ROCK CHESTNUT OAK. Quercus montana.

I have never found it growing to a large size, but usually between one and two feet in diameter, and forty to sixty feet high. One in Sterling measured six feet two inches at three feet from the ground. The trunk is covered with a dark, reddish-gray bark, often spotted with whitish lichens. The bark is somewhat lighter than that of the chestnut tree, and less rough than that of most other oaks, resembling that of the red oak, but smoother. The clefts are long, but not deep, and near each other, and rather smooth on their sides. The branches are not very numerous, making a sharper angle than in the oaks above mentioned; and the ultimate divisions are very small. The bark is very compact.

The leaves vary considerably in size and shape, — being from four to nine inches long, and two to five wide. They are borne on very short footstalks, obtuse and often unequal at base, sometimes broadest at the middle, but more frequently towards the extremity, with from six to thirteen large, rounded teeth on each side, which often end in a small hard point, the termination of the parallel nerves, which are connected by finely reticulated, parallel veins. They are of a polished green above; much lighter, and, in a young state, downy beneath.

When the trees are cut young, the stumps throw up shoots, of four feet or more in length, the first year.

This beautiful tree has many claims to attention. It is, according to the uniform testimony of those who have tried it as fuel, superior, for that purpose, to any other oak which will grow in the same situation, and it is generally considered superior to every other wood. Mr. Bull's experiments, made probably on another tree, would lead to a different conclusion, as he makes its value less than that of most other oaks.

As timber, it ranks, with many, next to the white oak. It is doubtless very valuable, but not more so than either of the preceding oaks.

The bark, wherever it has been used, is highly esteemed by tanners.

The acorns, which it produces as scantily and as rarely as either of the preceding, are large and very sweet.

But the chief recommendation of the rock chestnut oak is the situation in which it grows. It grows naturally and flourishes on the steep sides of rocky hills, where few other trees thrive, and where the other kinds of oak can hardly get a foothold. There are, probably, thousands of acres of hilly, rocky land, in almost every county in Massachusetts, where various kinds of evergreens have grown, unmixed with deciduous trees, until they have exhausted all the nutriment suited to their support, and where now, consequently, nothing thrives, which would furnish abundant support for this kind of oak.

It is well known that successive growths of trees of the same family exhaust the soil, in the same manner as successive crops of annual or other herbaceous plants of the same kind. And they not only exhaust it, but are, by some, without reason I think, supposed to fill it with excrementitious matter which is in a manner poisonous to analogous plants. The remedy, in cultivated lands, is a rotation of crops. The same suggests itself in the forest; and, whenever it can take place, a rotation is established by nature. But where no seed, of a kind entirely unlike that which has grown upon the soil, is found, unassisted nature cannot supply the want. In such cases, the art of man may come in with advantage. There is every reason to believe, that, if acorns of the oak of which we are speaking were planted on many hills which now bear nothing but stunted cedars, they would meet with the soil they want, and would flourish exceedingly well.

Sp. 7. The Little Chincapin Oak. *Quercus chinquapin.* Michaux.

Leaves and fruit figured in Michaux; Sylva, Plate 11; and in our Plate

This is much the smallest of the oak family which occurs in New England, seldom rising above five feet, and usually only

CHINCAPIN OAK. (*Quercus chinquapin.*)

two or three. It is found, scattered, in almost every part of the State. On Martha's Vineyard, it occupies, in some instances, many acres together, to the exclusion of almost every thing else. It is also abundant in some parts of Middlesex County. I have found it and the bear oak, chiefly, but not exclusively, on sterile soil. It produces great quantities of acorns, which seemed to be devoured with avidity by wild animals, and also by cattle and swine.

The recent shoots are of an olive or bronze green, smooth and shining, channelled, and dotted with small orange or yellow dots. The larger branches are of a light, shining, ashen gray; the stem dark, almost black, clouded often with light patches of membranaceous lichens. The fruit is borne on footstalks of half an inch in length, from the axils of the leaves, about the middle of the recent shoots. The cup is often set with several abortive acorns, which fall off when about one-fourth of an inch long. The leaves are obovate, tapering gradually to a petiole one-half to one inch long; they are obtusely pointed, sometimes nearly entire and sinuate on the border, usually with four to eight large teeth on each side, which terminate in a blunt, brownish, callous point; margin slightly revolute; surface light green and polished above, whitish or bluish, fine-downy beneath.

The bitterness of the bark shows that it abounds in tannin; and it might, doubtless, be advantageously used by the tanner, as the small branches of most of the oaks are in Europe.

Where this little oak constitutes the principal growth, it might easily be made to perform an important service. If the seeds of the pitch pine, the red cedar, the larch, or some of the valuable oaks, were placed, at the right season, an inch or less beneath the surface of the soil, they would spring up under its shade, and be protected by it from sun and wind, until they were large enough to need no further protection; after which it might be grubbed up, or left to die gradually in the shade.

Sp. 8. The Black or Yellow-barked Oak. *Quercus tinctoria.* Bartram.

Leaf figured in Michaux; Sylva, Plate 24; fruit, Plate 25. One variety is figured in Abbot's Insects of Georgia, II., Plate 56. The two most common forms are figured in Plates in this volume.

This oak is distinguished from all others by the rich yellow or orange color of its inner bark, and the same color, less deep, in the fruit. It is, usually, also remarkable for the black color of the external bark on the lower part of the trunk. But this characteristic often fails in young trees; the two oaks which follow being often dark in almost an equal degree.

The trunk, even in rather small trees, is excessively rough towards the base. In old trees, this extreme ruggedness extends throughout the trunk, and the bark is always remarkably free from the larger lichens.

The recent branchlets are brownish, or bronze red, somewhat channelled, and usually downy, closely dotted with minute gray dots, — with brilliant black dots, when seen under a magnifier. The older branchlets are of a grayish or pearly green, dots not much enlarged, surface soon clouded with pearly, membranaceous lichens. The buds are large, ovate, or pyramidal, reddish brown, or grayish, and pointed.

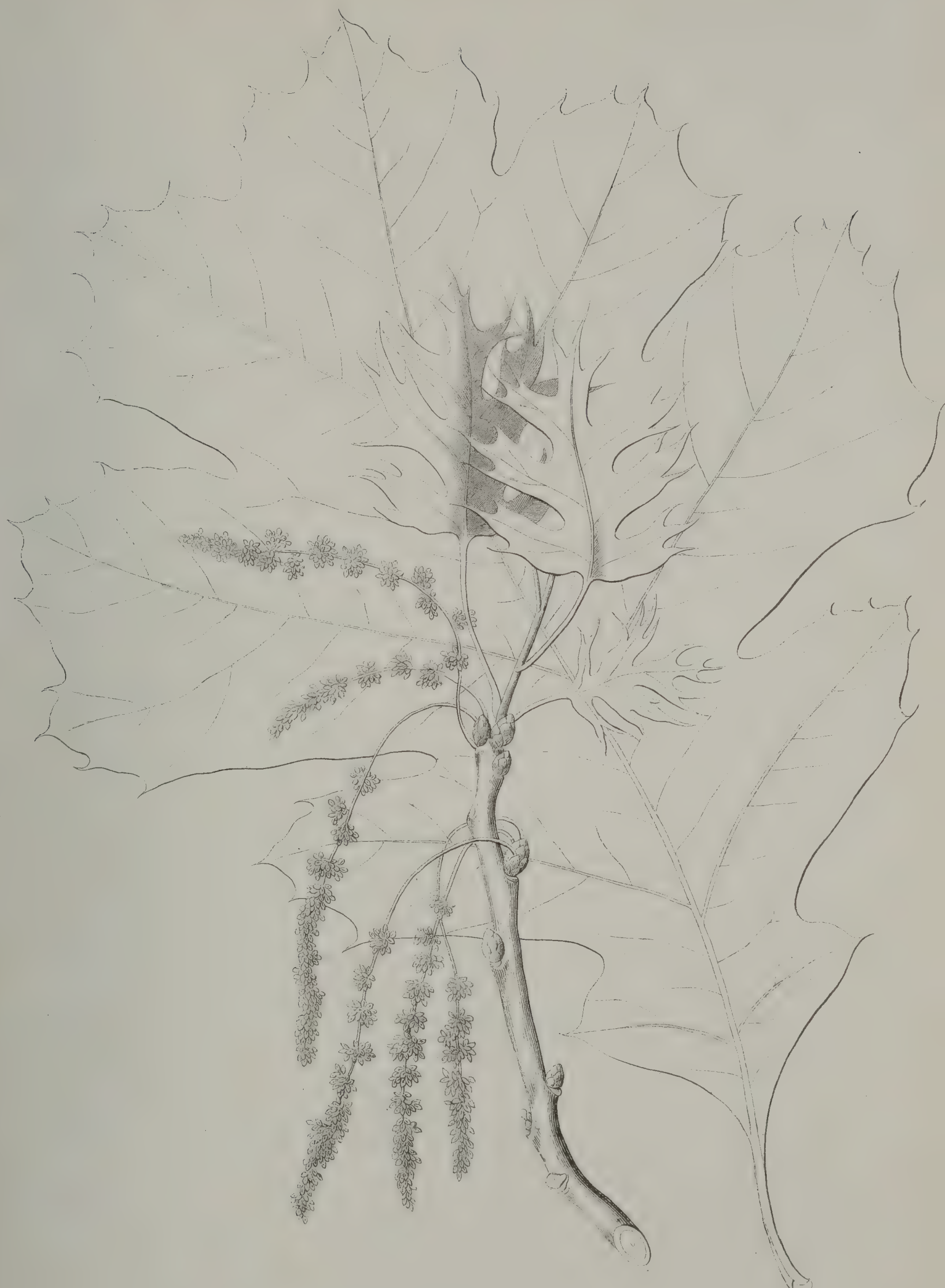
The staminate flowers are on a long pendulous thread, closely covered with down. Perianth downy, deeply divided into two to four fringed pieces; stamens four to six; anthers opening on the sides, to the base.

The fertile flowers nearly sessile, one, two, or three together, in the axil of a leaf; cup formed of several fleshy scales, — the outer ones narrow and pointed, the inner, broader; styles three, diverging, bearing recurved stigmas, issuing from an ovary which is surrounded by the fringed points of four to six segments of a perianth, all densely covered with down.

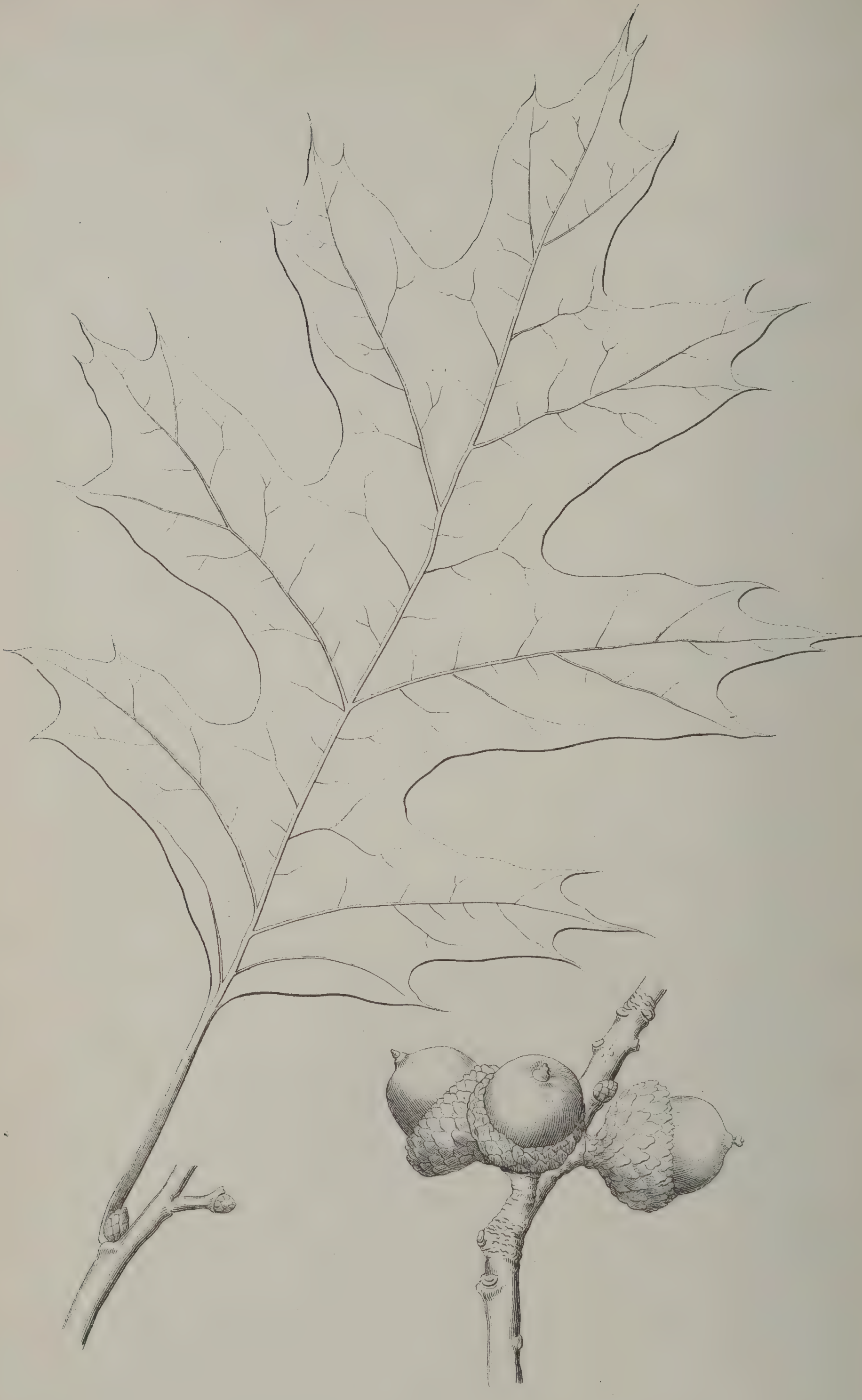
The acorn is small, of a flattened, globose shape, sometimes

Pl 14 Black Oak N. Y. Central Park

BLACK OAK. *Quercus tinctoria.*



BLACK OAK. (*Quercus tinctoria.*)



BLACK OAK. (*Quercus tinctoria.*)

beautifully striped with longitudinal bars of yellow and brown, in a very deep cup, of a brilliant orange within, lengthened downwards and gradually diminishing. The scales are free at their extremities, near the acorn, and waving. The kernel is of a yellowish or faint orange color, and very bitter.

The leaves are borne on long, rather slender, usually downy footstalks, inclined to yellowish green. They are inversely egg-shaped in their general outline, obtuse and unequal, rarely acute at base; on old trees, deeply cut by about three sinuosities on each side; on young and vigorous shoots, particularly on sprouts from a stump, more nearly entire. The lobes are usually broader, and the sinuosities less deep than in the scarlet oak. The lobes often enlarge towards the extremities, rendering the sinuses somewhat ovate: the primary and secondary veins end commonly in bristles. The surface is often dusty with a fine down above, still shining, and sometimes, in old leaves, smooth; beneath, downy, when young; smooth, or nearly smooth, when old, except at the axils of the veins, which are almost always downy. The color is usually much darker than that of the leaves of the scarlet oak, and the texture is thicker. They are often spread beneath with a ferruginous down, accumulated at the axils of the veins. Late in autumn, the leaves become of a rich, yellowish brown, or russet, or russet orange.

There are three pretty distinct varieties of the black oak. The first has its leaves full and almost entire, and running down along the footstalk; the second has leaves almost exactly resembling those of the scarlet oak, from which it cannot easily be distinguished but by the color of its inner bark. The third has leaves very broad at the extremity, and tapering much towards the base. These trees seem to be as different as the several varieties or species of the chestnut oak group. There are, probably, corresponding differences in the qualities of the wood.

For ship-timber, the wood of the black oak is next in value

to that of the oaks of the first division; and it is much used as a substitute for white oak, For floors and floor-timbers, it answers well, but is liable to decay, about iron. The grain is close and rather fine; the pores between the circles of growth are not large; the plates of silver grain, rather wide and near together. It has, therefore, great strength, and is extensively used by wagon-makers and other manufacturers in wood, being, for some purposes, superior to white oak.

The bark is highly valued by the tanner, as it abounds in tannin. It is liable, however, to the objection, that it gives a yellow color to leather, which is communicated to articles which remain long in contact with it.

The bark is also much used in domestic manufactures, for dyeing. With various preparations, it gives a great variety of shades of fawn color and yellow. From the inner portion of the bark is obtained the substance called quercitron, which was first brought to notice by Dr. Bancroft, and is used as a substitute for weld, in dyeing on a large scale. The colors given are fast colors. By a mixture of other dyes, as cochineal, several other shades, all rich and delicate, are given by quercitron.

This bark is not so highly valued as it should be. By means of it and the sumac, alders, birch, and some other barks, nearly all the colors necessary in dyeing might be obtained without cost, as the time of those who would prepare it is not commonly applied to any productive object, at the season when the preparation might be made.

Upon the leaves of the black oak, as also those of the red and scarlet, are often found smooth, round, light excrescences, called oak apples, one or two inches in diameter. They are formed by an extension of the cuticle of the leaf, which they resemble in color and consistency, enclosing a portion of fibrous, fleshy substance. This gradually shrinks to a brown, spongy mass, with a small woody kernel in the centre, and a thin, brittle, drab-colored shell. They are produced by an insect punc-

SCARLET OAK (*Quercus coccinea.*)

turing the healthy leaf, and depositing therein an egg, about which the apple forms. "A single grub lives in the kernel, becomes a chrysalis in the autumn, when the oak apple falls from the tree; changes to a fly in the spring, and makes its escape out of a small round hole, which it gnaws through the kernel and shell. . . . . The name of this insect is *Cynips confluens*."[1]

The black oak, far the most valuable of its group, is found in the southern part of Maine and in New Hampshire, and is more abundant in the eastern part of Massachusetts than any other oak, except the white. From the scarlet it is not usually distinguished, while standing, except by ship-builders. When felled, it is known by its thicker bark. It does not often attain a large size, being seldom found over four feet in diameter, and from forty to sixty feet high. In the Middle and Western States, it rises to the height of eighty or ninety feet, with a diameter of five feet or more. It is of a rapid growth, and flourishes even on poor soils.

A yellow bark oak, in Sterling, on a rocky hill on the lands of Mr. Stewart, measured, at the ground, thirteen feet in circumference; at three feet, nine; at six, eight feet one inch. It rises at least thirty feet in a straight, undivided column, without a limb, and with a gradual taper. It then begins to branch, and terminates at a goodly height, in a roundish head of few branches.

Sp. 9. The Scarlet Oak. *Quercus coccinea.* Wangenheim.

The fruit is figured in Michaux; Sylva, Plate 24; leaves on Plate 25; leaves and fruit on our Plate, of this volume.

This handsome tree is almost everywhere known by the name of the red oak, and is thence confounded with a tree which is inferior to it in every valuable property. The trunk is straight, rather rapidly, but not abruptly, diminishing. The

[1] *Harris's Report*, Cynips confluens, 546.

bark on small trees is of a reddish granite color, rough, with numerous short clefts; on older trees the bark has a bluish tinge, whereby it may be distinguished from that of the black oak. The recent branchlets are of a light purplish green, very smooth; older ones darker, purplish green; larger branches grayish.

The flowers appear in May; the sterile on a slender green thread, two or three inches long, set with a few scattered hairs. The perianth is brown, on a very short footstalk, single, deeply divided into four to six jagged, unequal, fringed lobes. The stamens are five (four to six), on filaments longer than the perianth, and a little hairy above and below.

The acorn is small, of a lengthened globose form, in a deep cup considerably prolonged at base, the upper edge of which is very abrupt, and the scales rather large, not free, but usually close at the edge of the cup, and hairy on the side edges. The kernel is white, and less bitter than that of the black oak.

The leaves are on long, slender, smooth petioles, irregular in shape, but oblong or roundish in the general outline, very deeply sinuate, with about three broad, rounded sinuosities; lobes long, acute-angled, or with their sides nearly parallel, ending in a bristle; thin and very smooth, and polished on both surfaces, except that they sometimes have a slight pubescence at the angles of the veins beneath. The leaves are commonly inequilateral and obtuse at base, though sometimes acute, and end in an oblong, narrow lobe, partially divided into three parts.

This tree may be usually distinguished from the black oak, at a little distance, by its more deeply cut foliage, and consequently lighter appearance, and also by the brighter and lighter hue of the leaves, and the brilliancy of the points of reflected sunlight. Yet, from the general similarity of the two, and the numerous varieties of each species, an inexperienced observer is very apt to imagine that he finds both in a forest made up exclusively of either; and it must be ad-

Sprague, del

Armstrong & Co. lith. 166 Congress St Boston.

SCARLET OAK. (Quercus coccinea.)

mitted, that they often approach so near each other in character, that it is exceedingly difficult to distinguish them without cutting into the bark, except after the change in the color of the foliage, which takes place in autumn. The rich and beautiful deep scarlet color, red dotted with crimson, or orange scarlet, of the foliage of this oak, separates it strikingly, at that season, from every other species.

To obviate the difficulty of discrimination, I have brought together the points of difference, by which they may be distinguished from each other, at any age or season.

In the black oak, the leaves are broader and fuller towards the end; larger, more nearly entire, and usually darker and thicker; on small plants they are more full and more nearly entire; the footstalk is stouter; the axils of the veins are very downy; and the leaf is more fully covered with down, on both surfaces, when young. The buds are larger, grayish, and downy; the young branches and shoots stouter; the acorn cup has the upper edge of the scales next the acorn loose and fringed. The stem of the tree is blacker, particularly towards the base, rougher, with chinks numerous, and black within; and the old bark not so fully covered with lichens. The kernel of the acorn, the inside of the acorn cup, and the inner portions of the bark, are of a rich orange color, and all intensely bitter.

In the scarlet oak, growing in the same forests, the leaves are fuller towards the middle, smaller, thinner, more deeply cut, and of a lighter and livelier color; on small plants, more deeply cut, but sometimes running down along the footstalk; the footstalk is longer and more slender, and both surfaces and the axils of the veins are always less downy. Young branches and shoots more slender and smooth; buds smaller, conical, obtusely pointed, brownish, smooth; in the acorn cup the extremity of the scales closer, and not forming so much of a fringe next the acorn. The stem is gray, with a bluish tinge, and less rough; chinks less numerous, light brownish within; the old bark, where smooth, covered with

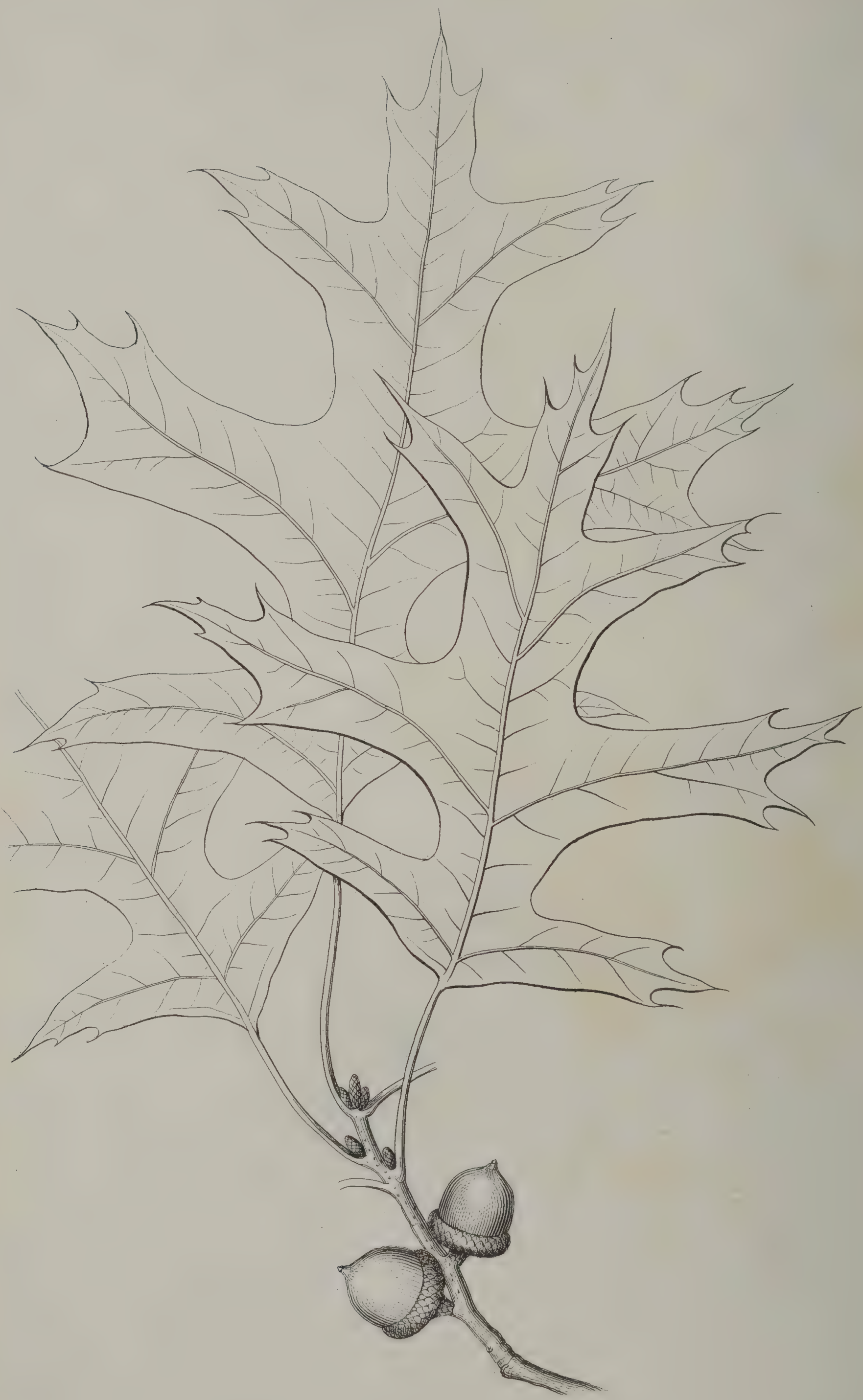
lichens. The kernel of the acorn and inside of the acorn cup, are white or pale yellow; inner portions of the bark reddish; all much less bitter.

The scarlet oak abounds in the eastern part of the State, forming a considerable portion of the oak forests in Plymouth and Bristol counties, and in the vicinity of Boston, — for thirty or forty miles on every side. It is found, also, but far less abundantly in the middle of the State, and in the river counties, but seldom occurs westward of the Connecticut.

As fuel, it is not commonly distinguished from the black oak, to which it is, however, decidedly inferior. It forms a large part of the wood which is imported into Boston from the south shore, or which is brought in from the neighborhood.

For the use of the tanner, it is still less valuable; the bark being much thinner than the yellow oak bark, and less abounding in tannin. It is, however, far superior to the bark of the red oak, with which it is constantly confounded, from having, in many places, the same name.

The scarlet oak, like the black, is a tree of considerable beauty at every season of the year. But in the autumn, when the whole forest has changed its color, the rich scarlet which its leaves assume makes it an object of conspicuous beauty. The leaves, after they have undergone this change of color, which has no dependence on the action of the frost, remain long upon the tree, and, in the natural forest, blend harmoniously with the dark brown of the red, the yellow of the old black oak, and the red hues of the young, and the deep rich purple of the still more persistent leaves of the white oak. Adding to these the various shades of crimson and orange of the maples and tupelos, you give to a stroll through the autumn woods in a pleasant day in the Indian summer, such a variety of attractions, that he who yields to them, and comes out to enjoy the scenery with its rich, mellow colors, and the soft, mild, and yet glowing atmosphere, each so made for the other, finds it difficult to persuade himself how so many can be induced to forego the enjoyment.



PIN OAK. (*Quercus palustris.*)

PIN OAK. *Quercus palustris.*

Neither the scarlet nor the black oak grows to a great size or height in Massachusetts, though in the Middle, Southern, and Western States, they are among the tallest oaks. I have not found many over five feet in diameter. One, in Natick, near Mr. Jonathan Bacon's, measured sixteen feet four inches in circumference at the ground, but diminished rapidly, being only ten feet, at four feet above. The scarlet has less of the tendency to spread than most other oaks, but is a graceful tree, presenting in its shape and limbs an endless variety of beauty.

Sp. 10. The Pin Oak. *Quercus palustris.* Willdenow.

Figured in Michaux, Sylva.

Of this tree Michaux says, "Its secondary branches are much more slender and numerous than those of a tree having such large dimensions could be expected to be; and they are so intermingled as to give it, when viewed from afar, the appearance of being set with pins, whence probably its name. The leaves are on long petioles, of a bright green, and smooth on both surfaces; deeply lobed, with broad, rounded sinuses, lobes very divergent and sharply cut. The base of the leaves forms a larger angle with the stem than those of any oak except the scarlet oak, from which it is distinguished by the lobes being more divergent, of a brighter green, and the whole leaf being much smaller."

This tree escaped my notice before the first edition of this work was published, though I had been always expecting to find it. I am therefore not able to give so full an account of it from my own observation as I have of each of the other trees in the State. It is found west of the Connecticut River, and, rather rarely, in the eastern counties.

Loudon says of it, as he saw it growing in England, "The tree, when young, assumes an agreeable, pyramidal shape; and its far-extending, drooping branches, and light and elegant

foliage, render it, in our opinion, the most graceful of all the oaks. The bark, on the oldest trees, is scarcely ever cracked. On young trees, it is perfectly smooth. In the climate of London, the tree is remarkably hardy; and its rate of growth is much more rapid than that of almost any other American oak."

Of the character and qualities of the wood I know nothing from my own observation, or from personal inquiries. It is certainly a beautiful small tree, and deserves to be cultivated on that account.

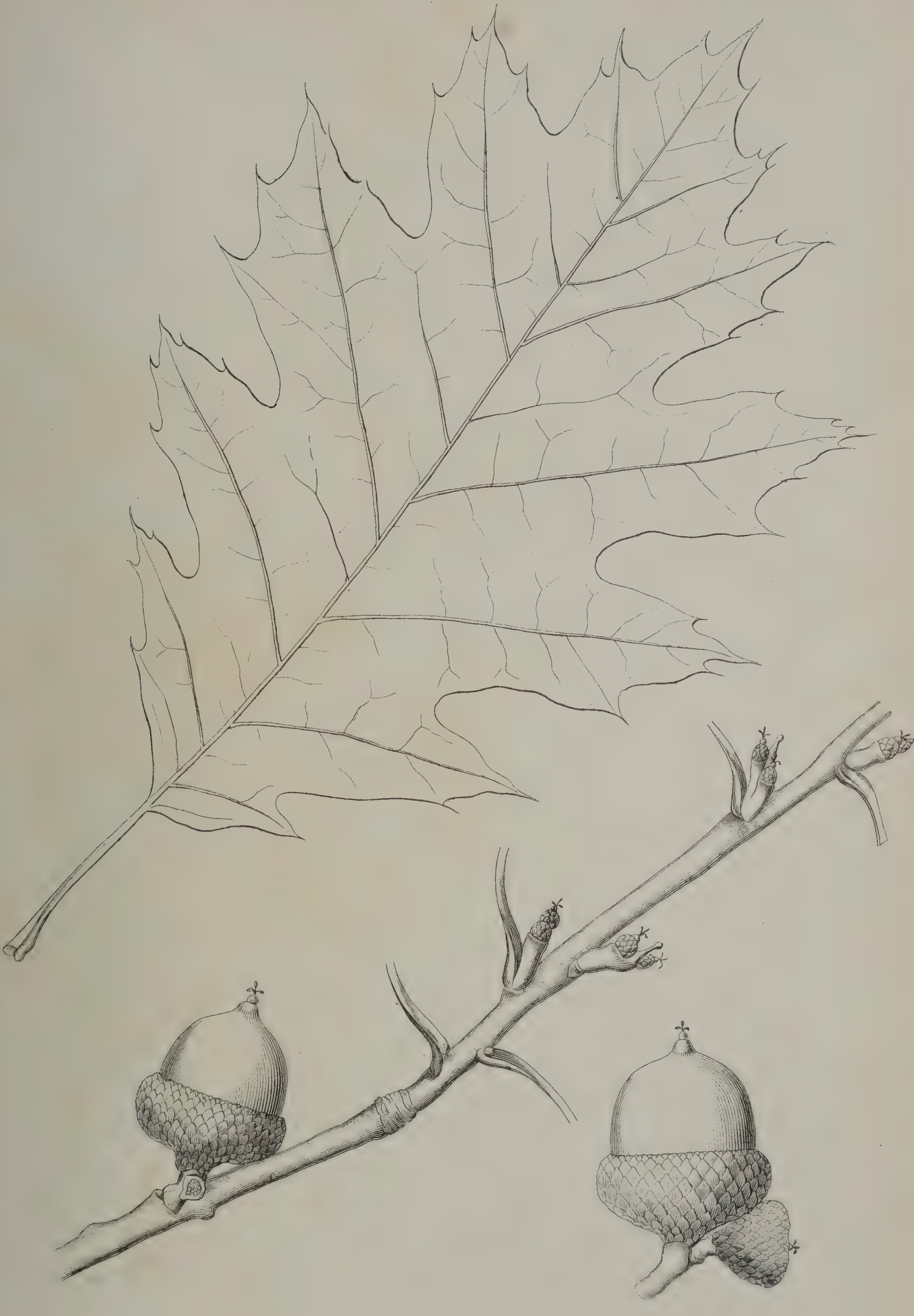
Sp. 11. The Red Oak. *Quercus rubra.* L.

Figured very poorly in Abbot's Insects of Georgia, II., Plate 103; well in Michaux; Sylva, I., Plate 28; also figured in our Plate in this volume. The tree in Loudon, VIII., 271, from which one of ours is taken.

The red oak is the most northern of the oaks. According to Dr. Richardson, it is found as far north as the Saskatchawan, and the rocks at Lake Namakeen. It is common in all the New England, Middle, and Southern States, as far as Georgia, and on the western declivities of the Alleghanies. Like the elm, it comes to its greatest perfection in Massachusetts, perceptibly diminishing in vigor and luxuriance of growth, farther towards the north, and not increasing in either towards the south. This tree is found in every part of Massachusetts, growing freely in every variety of soil, even the poorest. It is known by several names, — the red, the black, and the gray oak. The most general, as the most appropriate name, is the red oak, as the mid-rib and veins of the leaves are often of a rich red color in the latter part of autumn; and the leaves turn to a uniform dark red before they fall.

The trunk is of a dark greenish ashen gray, continuing smooth longer than any other tree of the genus, and never becoming extremely rough. The bark on the recent branchlets is of a polished brown, with minute dots; during the next

RED OAK. *Quercus rubra.*



RED OAK (*Quercus rubra.*)

year it has a pearly hue, which it exchanges for a deep green, gradually turning to the uniform, greenish gray of the trunk.

The leaves are oblong or lance-shaped in their general outline, larger towards the end, and contracted towards the base. The lobes are five or six on each side, separated by a rounded, not very deep, sinus; the lobes sharp and terminating in bristles. The leaf is obtuse, or, more commonly, acute at base; the texture thin and membranaceous; the color of a lively, shining green above, paler, but shining beneath.

The acorns are larger, and contained in a broader and shallower cup, than those of any other northern oak. The cup is invested with narrow, thin, and very close scales. The kernel is whitish, and bitter to the taste; but the acorns are eagerly sought after by cattle and swine, though they seem not to be much in request with the smaller wild animals.

The red oak is of little value for fuel or for most purposes as timber. I am informed by a reliable gentleman that the young green branches burn more readily and give out more heat than the dry branches. He thinks there is something oily in them. The sour and acrid juices, which can hardly be expelled from the wood by natural or artificial seasoning, rapidly corrode iron spikes which are driven into it; and the bark is almost worthless for the use of the tanner. Beams made of it, and employed in the frame of buildings, have, indeed, been found free from decay at the end of a century; and it is easily distinguished, even at that age, from the wood of any other oak, by its not having become seasoned, and by its thence imperfect combustibility. From having names given it which belong to far more valuable species, it has, in many places, a better reputation than it deserves. It is used, and that only for inferior purposes, where no other species of oak can be obtained.

But, like some individuals in a higher field in creation, it compensates in some measure for its comparative uselessness, by its great beauty. No other oak flourishes so readily in

every situation; no other is of so rapid growth; no other surpasses it in beauty of foliage and of trunk; no oak attains, in this climate, to more magnificent dimensions; no tree, except the white oak, gives us so noble an idea of strength.

A red oak, in Lancaster, at the foot of George's Hill, west of the north branch of the Nashua, measured, in 1840, seventeen feet in circumference at three feet from the ground, and fourteen feet ten inches at six. A wall prevented its being measured at the surface, where it is much larger. It continues very large for eighteen or twenty feet, when it divides into four or five very large limbs, which spread and form a fine round head. I have found many other large trees.

It is of singularly rapid growth from the stump, the shoots rising sometimes to six feet or more in one season. Careful measurements of a great number of trees recently felled, show that, for the first thirty-five years, this tree increases at the rate of about two inches in diameter every eleven years.

Next to the red oak the younger Michaux placed the gray oak, which, however, after a vast deal of examination, I am obliged to consider as only that form of the red oak, which most usually occurs throughout the New England States. The leaf which he has figured for that of the gray oak, is by far the most common form of the leaf of the red oak on all young and growing trees. The fruit is such as is often found on the red oak; the cup varying on different trees, by imperceptible gradations, from a shape shallower and broader than that he has figured for the red oak, to one narrower than that he has given to the gray oak.

Sp. 12. The Bear Oak. *Quercus ilicifolia.* Willdenow.

Figured in Michaux; Sylva, I., Plate 21; and our Plate in this volume.

This little oak is found on poor soils in every part of Massachusetts. It is commonly known by the name of the scrub oak, or dwarf red oak, and sometimes bear oak, from the fond-

BEAR OAK. (*Quercus ilicifolia.*)

ness of bears for its fruit. It is usually not more than six or eight feet high, and an inch or two in diameter; but sometimes attains the height of fifteen or eighteen feet, and the diameter of eight or nine inches. Mr. M. Pratt, of Concord, tells me that he has recently measured one of two bear oaks from the same stump, which is 25 feet and 8 inches in height, 22 inches in circumference on the ground, and $20\frac{1}{2}$ inches as high up as he could reach. It is covered with numerous large, scraggy branches, with small branchlets.

The recent branchlets are of a light ashen gray, greenish, or of a clouded brown, with a velvet-downy surface. Older ones, greenish, dotted with gray. Stem, a rich green, with numerous dots, and occasionally light clouds, and a transparent, pearly, shining epidermis, growing darker when old; covered in patches, and often completely covered, like other smooth-barked trees, with lichens of various colors, usually dark, or nearly white.

From the axil of the lower leaves on the newly formed shoots, rise, on short footstalks, next year's fruits, two or three together, crowned with their three stigmas.

The leaves are on short petioles, wedge-shaped at base, obovate, somewhat lyre-shaped, with two or three obtuse sinuses on each side, the larger ones about the middle of the leaf; the lobes ending in a bristle, or often entire, four or five-angled, as broad as long; of a deep shiny green color and smooth above, whitish or ashen-downy beneath, the down abundant in the axils of the veins.

The leaves are about two and one-half or three inches long, and one and one-quarter or one and one-half broad; on petioles often very short, often one-half or three-fourths the length of the leaf.

The acorns are often beautifully striped longitudinally. The base of the acorn, where it is attached to the cup, is of a deep orange, as is the kernel.

The sterile flowers are in thread-like catkins, one to two

inches long, on the base of the recent shoots, or scattered profusely along last year's shoot, in the axils of last year's leaves.

Thread downy; calyx hairy; segments rounded or torn; stamens four, on short filaments.

Fertile flowers in the axil of the recent leaves, nearly sessile; perianth downy; the three stigmas prominent, divergent.

Leaf-stalks, recent shoots, and under surface of the leaves, covered with a soft, grayish down.

The bear oak is generally considered of very little value, and is often regarded as a nuisance. It might, doubtless, be turned to some advantage. It grows readily in the most exposed situations and poorest soils, and produces a great abundance of fruit. Michaux suggests that it might be usefully employed as a hedge, by being sown in three parallel rows, ten or twelve inches apart. The plants would soon attain sufficient height and strength to serve as a barrier against cattle, and would be an agreeable object to the eye. It might also be employed to perform the office which it often performs in nature, — that of protecting the young of more valuable trees, in the manner which has already been suggested in the description of the little chincapin oak.

The oaks found in New England naturally arrange themselves in four groups, in the order, as far as I understand their character, in which I have described them. To the first belongs the white oak, which is most nearly allied to the two varieties, as the Continental botanists consider them, of the European white oak. Next to the white oak, are to be arranged, at nearly equal distances about it, the overcup, the post and the swamp white oak, forming a second group, with qualities very nearly like to those of the first. Of these, the last is most remote, and connects them with the chestnut oak group, to which the elder Michaux considered it as belonging. This third group includes the chestnut oak, the rock chestnut, and the chincapin, with the chestnut white oak of a region further south.

All these slide, by almost imperceptible gradations, into each other. The fourth group, entirely distinct, includes the black, the scarlet, the pin, the red, and the bear oak, so nearly allied as to be generally considered the "red oaks;" and in many places this single name includes them all.

ON PLANTING WITH OAKS.

The value of oak timber is already so great, and it is so constantly and surely increasing, from the diminution of the home supply, and the increased difficulty of getting it from abroad, all the kinds of oak, are, moreover, of so slow growth, and the number of years necessary to create a forest so very great, and dependence on a foreign supply is so unsafe, that it is obviously important that means should be immediately taken to convert into future forests some of the many thousand acres susceptible of this, which are now lying waste.

I shall, therefore, make no apology for giving a brief account of the means which have been most successfully used in England and on the continent of Europe, for the forming of oak forests.

In Britain, innumerable experiments have been tried, ever since the days of Evelyn. For the details of these, I must refer to the many publications on the subject which have been made in that country, particularly to Loudon's "Arboretum," which gives a historical view of all the most important ones:—

"Artificial shelter," says Loudon (*Arb.*, IV. p. 1800), "it is allowed by almost all writers on the culture of the oak, is essentially necessary to ensure the rapid progress of a young plantation. This arises from the natural tenderness of the young shoots and early leaves of the oak, which, even in the south of England, are frequently destroyed or much injured by frost in May; while, in elevated situations, it is found that

even the bark does not so easily separate from the wood of standing trees after a cold night. Modern planters seem to be all agreed, that the best mode of producing shelter for the oak is by first covering the surface with the Scotch pine, larch, or birch; the first being greatly preferred. After the nurse-trees have grown to the height of four or five feet, openings should be cut in the plantations thus formed, — at the rate of from three hundred to five hundred according to some, and of sixty to one hundred according to others, to the acre; and in each of these openings an acorn, or an oak plant should be inserted, the soil having been duly prepared."

Young oaks are frequently injured by late frosts in all the lower parts of Massachusetts, and the precautions directed above must be not less necessary in our climate than in the comparatively mild one of England. Instead of the plants recommended by Loudon as nurses, our pitch pine, hacmatack, and black, yellow, or white birches, might be used, all of which spring readily from seed.

"The patches are prepared by digging and manuring with lime; and each is planted with five acorns, one in the centre and four around it. After two years' growth, all the plants are removed but one, by cutting through their roots, two to four or five inches below the ground, with a sharp, chisel-like instrument with a long handle, made on purpose; the plants removed not being intended to be replanted. As soon as the nurses overshadow the oaks, the plants that do so, or their branches, are to be removed; but 'all the Scotch pines and larches that will require to be taken out before they are sixteen years old,' Mr. Cruickshank says, 'will not render the plantation thinner than a thriving one of the same kind of trees would, for its own sake, need to be at twenty years after planting.' When the oaks are five years old, they are to be pruned for the first time, by cutting off the lower tier of branches close to the stem; and this operation is to be repeated every two years, till the oaks are between thirty and

forty years old. 'Two thousand of the Scotch pines and larches,' Cruickshank adds, 'may be allowed to remain, not only without injury, but with advantage, to the oaks, till they are sixteen years old.' Half of them may then be cut down, one half of the remaining one thousand at twenty-five years old, and the remaining five hundred at from thirty to thirty-five years old. 'To plant nurses, therefore, is attended with very great pecuniary advantage. It will not only return the whole expense laid out in making the plantation, but produce a very high rent for the land during the first thirty or thirty-five years; whereas, if oaks alone were planted, nothing could be gained during this period, except by cutting them down when between twenty and twenty-five years old, for the sake of their bark." — *Arb.*, p. 1801, 1802.

When the new plantations in the royal forests (now exceeding forty thousand acres) were begun, the most skilful and experienced planters of oaks, in all parts of the kingdom, were consulted as to the best modes of planting, and particularly in reference to the use of Scotch pines as nurses. Very various and somewhat discordant opinions were given, and, in consequence, several different methods were pursued, and with various success.

"For several years past," according to Alexander Milne (*Loudon*, p. 1803), the plan pursued at the New Forest "is to plant the enclosures with Scotch pines only, as soon as they are fenced in and drained (if draining is required); and when the pines have got to the height of five or six feet, which they will do in as many years, then to put in good strong oak plants of about four or five years' growth, among the pines, not cutting away any pines at first, unless they happen to be so strong and thick as to overshadow the oaks. The advantage of this mode of planting has been found to be, that the pines dry and ameliorate the soil, destroying the coarse grass and brambles which frequently choke and injure oaks; and that no mending over is necessary, as scarcely an oak so planted is

found to fail. It is not an expensive method of planting, especially if the plants are raised on the spot."

Instead of the pitch pine, the European larch, the wood of which is far more valuable, may be employed. But the Scotch pine promises to be the best.

In many cases, the young pine woods already exist, and it would be only necessary to sow the acorns or set the young plants among them. As has just been seen, the latter method has been preferred in England, where labor is much less expensive than here, and timber is so much more valuable that it is of great importance to save some years in the growth of the trees, as is supposed to be done by the planting of young trees. But, in consequence of the great cost of labor in this country, it would be desirable to sow the acorns where the trees are to stand, if any way could be contrived to defend them from mice and squirrels; and this might probably be done by sowing a sufficient quantity to allow for the destruction which would be caused by these animals. And there are many arboriculturists, even in England, who prefer to sow the acorn where the tree is to remain.

As to the management of the acorn, the following extract from Loudon will give the most approved mode: "The acorns need not to be gathered from the tree, but may be collected from the ground immediately after they have dropped; and, as in the case of other tree seeds, they may be either sown then, or kept till the following spring. If they are to be kept, they should be made perfectly dry in the sun, or in an airy shed, mixed with dry sand, in the proportion of three bushels of sand to one bushel of acorns, or with dry moss; and then excluded from the air and vermin, by being put into barrels or boxes, or laid up in a cellar, or buried in heaps, and covered with a sufficient thickness of earth to exclude the weather. If the acorns are to be transported from one country to another, the same mixing with dry sand or dry moss, and exclusion from the air, is adopted; but the more certain mode

of retaining the vital principle in acorns is, to mix them with moist earth, or with moist live moss (*Sphágnum*) : in either of the latter mediums, they will germinate during a long voyage ; but no evil will result from this, provided they are sown immediately on their arrival. When acorns are to be sown in a nursery, the soil ought to be thoroughly prepared and rendered fine ; and, after the earth is drawn off the beds, or the drills opened, the acorns may either be scattered over the beds, or along the drills, so that the nuts may be about two inches apart ; and, to regulate this distance with greater certainty, the sand may be separated from the acorns with a sieve. In either case, the acorns, before covering, must be patted down with the back of a spade in the beds, and with the back of a wooden-headed rake in the drills. The covering, which ought to be of well-broken soil, should vary in depth, according to the size of the acorn ; one and one-half inches being enough for those of the largest size, and one-half inch for those of the smallest size. No mode of depositing acorns in the soil can be worse than that of dropping them in holes."

It is often asked why young trees, generally, and oaks in particular, when imported from the nurseries in England, succeed more certainly and grow more rapidly than similar plants taken from woods or open grounds in the neighborhood. One reason probably is, that all the oaks throw down a long tap-root, and for the first few years have very few lateral fibres.[1] When, therefore, a young tree is removed at once from the

[1] Another reason is, that young trees taken from a nursery, have been somewhat exposed to the sun's direct light, and to the wind. Whereas, when taken from the forest, they are often transplanted from completely sheltered situations, where they have been protected from sun, wind, and cold, and have, in consequence, a thin, delicate bark, inadequate to protect them in a more exposed situation. Young trees should be taken for transplantation, from openings in the forest, or from the edges, where they have been somewhat exposed, and thereby prepared to sustain the exposure to which they will be subjected. Otherwise they suffer, just as the young of any other living beings would, which, after having been nurtured delicately and in seclusion, should be suddenly exposed, unprotected, to the inclemencies of the elements.

spot on which it grew, to that on which it is to stand, the end of the tap-root is almost necessarily broken off or much injured, always much retarding, — sometimes fatally, — the progress of the young tree. To obviate this evil, the French nurserymen make the acorn or other seed germinate in moist earth or sawdust, and, before planting it, pinch off the end of the root. This causes the plant immediately to throw out side fibres. For the same purpose, it is the practice in England either to transplant the oak after one or two years' growth, removing at the time a part of the tap-root, or to cut it off without removing, by inserting a spade, obliquely, six or eight inches beneath the surface. In either case, the plant has several roots to depend upon, in place of its single original tap-root. In some cases, after it has grown in the place where it is to remain, for two or three years, it is cut down to the ground ; it will then throw up vigorous shoots, and send down perpendicular roots. All but the most promising of the shoots may be carefully removed. This has been tried with marked success by Morrill Allen, of Pembroke, who has paid much attention to the cultivation of the oak.

The foreign oaks which seem most worthy of cultivation in this State, are the two varieties of the oak of England. Both these have been introduced, and are growing in various situations in the neighborhood of Boston. They are perfectly adapted to our climate, and flourish as well and grow as rapidly, and mature their abundant acorns as surely, as any of our own oaks, except the red. When young, they are extremely beautiful and ornamental, and, when full grown, they are among the most magnificent trees known. As objects of beauty, and for their value in the art of ornamental culture, as well as for use, no foreign trees present so strong claims to our attention. The oaks which deserve to be recommended as most valuable additions to the forests of the eastern part of the State, are the overcup, the two chestnut oaks, and the post oak.

The oaks are better fitted than almost any other trees, to stand along the borders of cultivated fields ; as, where the soil is deep enough to allow it, they send their roots to a considerable depth, and thus disturb but slightly the growth of grass and other herbaceous plants and low shrubs.

II. 2. THE BEECH. *FAGUS.* Tournefort.

Lofty, spreading trees of the cool regions of Europe and America, distinguished for their smooth ashen or bluish gray bark, and three-cornered, oily nuts, protected by a bristly, or prickly, four-cleft bur. The leaves are annual, alternate, and plaited while in the bud, which is sessile, and covered with imbricate scales. The male flowers are in roundish, tassel-like aments, dependent by a long, silken thread. The females, in roundish, sessile aments. Of this genus, De Candolle, "Prodromus," § xvi., makes sixteen species; one is the common beech of Europe and the western part of Asia, — a tree of beauty and value, of which a representation is given in our Plate, European Beech (*Der Wald*), and of this, the American is supposed to be a variety; six are found in Chili; one or two, possibly three, are natives of Terra del Fuego; one of Japan; and several of New Zealand.

The American Beech. *F. Sylvatica*, L., var. *Americana*, Nuttall. *Sylvestris*, Michaux.

Figured in Michaux; Sylva, III., Plate 107; Abbot's Insects of Georgia, II., Plate 75.

For depth of shade, no tree is equal to the beech; and as it is singularly clean and neat, and the leaves are liable to the attack of few insects, and remain on the branches longer than those of any other deciduous tree, giving a cheerful aspect to the wood in winter, it deserves cultivation near houses.

The roots do not penetrate deeply, but extend, just below the surface, to some distance on every side. The stem is remarkable for its smooth bark, of a whitish or bluish gray or lead color, sprinkled with ash. When growing freely, it is an erect, often fluted, column of eight or ten to twenty feet, at which height it throws out, in every direction, many long,

EUROPEAN BEECH. *Fagus sylvatica.*

diverging or radiating arms, stretching upwards and outwards, at a large angle with the trunk. The lower branches of the lower of these gradually become horizontal, while the upper ones ramify so as to form a broad, round, dense head. In the thick woods, it shoots up in a straight, erect trunk, to a height of sixty or seventy feet, clear, or with here and there a small, slender branch. The branches of the tree growing freely, or on the edge of a wood, are sometimes large, but more frequently small, numerous, and irregular; the branchlets various, every second or third larger than the others; the spray short and distant, making sharp angles, slender and tapering to a point, with shining, deep purple bark, or of a beautiful chestnut red, indistinctly dotted with brown. The older branches become grayish, and gradually assume the blue gray of the trunk. On small trees, the bark is of a light, polished, leaden gray. The tree has its finest shape when growing in an open forest, which has been made so by gradual clearing. It then unites magnificent height with great amplitude and length of head.

In an old tree the bark is rarely seen. But every part is usually covered with thin, membranaceous lichens (*Lecanoras*, *Lecideas*, *letter-like Opegraphas*), in clouds of every shade of white, gray, and brown, outside which are often large patches of gray, yellow, and sulphur-colored foliaceous lichens (*Parmelias*). Near the bottom, when growing in the forest, it is pencilled with delicate, threadlike, branching jungermannias, and, about its base, has tufts of green and purple mosses.

In winter, it is distinguishable by its long, spindle-shaped, pointed buds.

From the density of the shade, from the slowness of the decay of the leaves, and from the fact that the roots run near the surface, few herbaceous plants are found beneath the beech. From these roots, however, young trees are often seen to spring; and this seems to be one of the ways in which the beech is propagated. When a tree is felled, the trunk

throws out a profusion of shoots, which flourish for a year or two, and then perish. The leaves, on these shoots, are usually of a rich crimson color.

The leaves, on old, fruit-bearing limbs, are in stars of four or five, at the ends of the branchlets. On the growing shoots, they are alternate, often inequilateral, on short, often hairy, petioles, which grow from the under side of a branch, and bend upwards. They are broad, lanceolate, narrowed below, and somewhat heart-shaped, acuminate; the nerves parallel, never branched, ending in a single, large tooth. The surface is polished and shining, lighter beneath and hairy while young; texture thin and membranaceous. The leaves come out late, but often remain on the tree through the winter. The stipules are very long, slender, delicate, and very transient.

The showy and beautiful flowers are in roundish tassels or heads, dependent by threadlike, silky stalks, of one or two inches in length, from the midst of the young leaves of a newly opened bud, whose long, delicate, ribbon-like scales are still adhering. Each flower is a hairy or silky, bell-shaped cup, with its border divided into six segments, and contains usually from six to twelve stamens. The fruit is on a hairy footstalk, from the axil of a leaf. The footstalk enlarges upwards into four fleshy, lanceolate scales, fringed, and set with stiff, sometimes double prickles. As it ripens, these open, disclosing two prismatic, triangular nuts, whose edges thin out into a waved border.

The fruit, called beech mast, is a rich, oily nut. It is eagerly devoured by pigeons, partridges, squirrels, and other wild animals. Bears are said to have been very fond of it, and swine rapidly fatten upon it. Most varieties are so small as not very richly to repay the trouble of gathering, drying, and opening them. Fortunately, this is not the case with all, as the mast is a delicious nut. In France, the beech mast is much used for making oil, which is highly valued for burning in lamps, and for cooking. In parts of the same country, the nuts, roasted,

serve as a substitute for coffee.[1] In Germany, the juice and the ashes were formerly, and perhaps are still, considered very efficacious applications for ulcers.

The leaves were formerly used in Britain, and are to this day in some parts of Europe, for filling beds.[2] Evelyn says that "its very leaves, which make a natural and most agreeable canopy all the summer, being gathered about the fall, and somewhat before they are much frost-bitten, afford the best and the easiest mattresses in the world, to lay under our quilts, instead of straw; because, besides their tenderness and loose lying together, they continue sweet for seven or eight years long; before which time straw becomes musty and hard: they are thus used by divers persons of quality in Dauphiné; and, in Switzerland, I have sometimes lain on them to my very great refreshment. So as, of this tree it may properly be said,

'Silva domus, cubilia frondes.'—*Juv.*
'The wood's an house, the leaves a bed.'"—*Sylva*, HUNTER's ed., p. 141, 142.

"We can," says Sir Thomas Dick Lauder, after quoting this passage, "from our own experience bear testimony to the truth of what Evelyn says here, as to the excellence of beech leaves for mattresses. We used always to think that the most luxurious and refreshing bed was that which prevails universally in Italy, and which consists of an absolute pile of mattresses filled with the elastic spathe of the Indian corn; which beds have the advantage of being soft, as well as elastic; and we have always found the sleep enjoyed on them to be peculiarly sound and restorative. But the beds made of beech leaves are really no whit behind them in these qualities, whilst the fragrant smell of green tea, which the leaves retain, is most gratifying. The objection to them is the slight crackling noise which the leaves occasion, as the individual turns in bed; but this is no inconvenience at all; or, if so in any degree, it is an inconvenience which is much overbalanced by the advantages of this most luxuriant couch."

[1] *Loudon's Arboretum*, p. 1963. [2] Ibid.

The white beech grows in every part of Massachusetts, but it is only in the forests of the western part that it attains its greatest height. It is there sometimes not less than one hundred feet high.

It flourishes best in a rocky, moist soil; and, where this is rich, it grows with great rapidity, sometimes increasing two-thirds of an inch in diameter in a single year.

The wood is hard, of a fine, smooth, close grain, and very dense, having a specific gravity of .724. It is excellent for the turner's use, and fine large bowls, trenchers, and trays are made of it. In the northern part of the country, it is much used as fuel, and ranks next to rock maple. It is said to gain hardness and strength by being immersed, for some weeks, in water.

It is preferred to all other woods for the making of plane stocks; and, for this purpose, the wood which has grown most rapidly is found not only to have the smoothest and closest grain, but to be most durable and least liable to warp. Plane stocks are, therefore, usually made of the outer, white, or sap wood; the heart, or red, being less tough.

It is also used for chair posts, of which great numbers are made of it in Becket and the neighboring towns. It is used for saw handles, and for bodies of carts; it answers well for lasts, and is preferred for the cylinders used in polishing glass.

It is a valuable wood for fuel, comparing with hickory, according to Bull, as 65 to 100, and its ashes furnish a great quantity of potash. In Italy the bark is used for tanning.

The beech is of a very rapid growth; but it is seldom found over two and a half or three feet in diameter, and is universally considered a comparatively short-lived tree. Large trees are very often found decayed at heart; and it probably reaches maturity, and begins to decay, in less than two centuries. An American beech in Cambridge Botanic Garden measures, in 1874, 5 feet 10 inches at 3 feet from the ground; a European, 5 feet 3.

From its rapid growth and thick shade, it recommends itself as a screen against wind, to give shelter to a garden. But it has the disadvantage that nothing will grow under it, nor well, very near it. It is wanting in gracefulness, but there is an animating play of light from its polished leaves, and this, contrasting with its great depth of shade, makes it an agreeable object.

I have been unable to find more than one kind of beech in Massachusetts. The workers in the wood speak commonly of the white and the red; and I have often gone in pursuit of the varieties. But I have not succeeded in detecting any specific difference, and believe the appearance in the wood which has given rise to these names to be produced by its more or less rapid maturation. The heart wood is of a reddish hue. Where it predominates, the log is called red beech. Timber, in which the white sap wood is most conspicuous, is called white beech.

The beech is said in Europe never to be struck by lightning. In travelling through a forest country, many oaks may be found which have been so struck, but never a beech.

The beech of Europe which, in Italy, lives more than 220 years, differs so little from varieties of the American that some botanists think them one species. There is doubtless a resemblance. But I am inclined to consider them distinct; much more distinct, certainly, than any varieties which I have been able to find in New England are from each other. The leaves of the European beech are well characterized by Willdenow as "ovate, smooth, obsoletely dentate, and ciliate on the margin." They are acute at each extremity. Those of our beech are narrow at base, and usually heart-shaped, decidedly serrate, or sometimes dentate, acuminate, and ciliate only while young; when they are not narrowed at base, they are strongly cordate. They are much larger than those of the European, and longer in proportion to their breadth; and the petiole, as well as the stalk of the fruit, is much less hairy. The aspect of the two

trees is nearly the same. In the European, the difference between the sap and the mature wood is very slight; in the American, it is striking. I have retained the specific name *Sylvatica*, as that by which our beech has been generally known.

There are several beautiful varieties of the European, propagated by budding, grafting, or in-arching, which deserve the attention of American arboriculturists. Among the most remarkable, are the Purple, or Copper beech, and the Weeping. The original tree from which all the varieties of the former of these have been propagated, is said to have been discovered, by accident, in a wood in Germany, towards the end of the last century, and it is supposed to be still standing. "In early spring, when the leaves of the purple beech are agitated by the wind, during bright sunshine, their clear red gives the tree the appearance of being on fire; an effect, Bosc observes, so truly magical, that it is scarcely credible by those who have not seen it." — *Loudon.*

II. 3. THE CHESTNUT. *CASTANEA*, Tournefort.

A genus containing a single European species, which is also American, two dwarf species found in this country, an evergreen species on the hills of Oregon, and several species lately discovered in Nepal and Java, in Asia, — with deciduous, alternate, usually long, narrow, and pointed leaves. The male flowers are in long, showy, rigid, axillary aments, which appear late, and soon fall; the female, in a bristling involucre, which enlarges to a prickly bur, containing from one to three smooth, roundish, thin-shelled, farinaceous nuts. It has a near alliance with the beech.

CHESTNUT. *Castanea vesca.*

AMERICAN CHESTNUT (*Castanea vesca.*)

THE AMERICAN CHESTNUT. *Castanea vesca*, Gærtner, var. *Americana*, Michaux.

Figured in Michaux; Sylva, III., Plate 104. The tree in Loudon, VIII., 257, from which our figure is taken.

This is one of the largest and tallest of our forest trees. It rises, with a straight, erect stem, hardly diminishing in size, to the height of sixty or seventy, and, in the forests in the south-west part of the State, to ninety or one hundred feet. The bark on the old stocks is of a dark color, very hard and rugged, with long and deep clefts. In smaller trees, it is remarkably smooth, and so continues till they have attained a considerable size. When they are a foot or more in diameter, it begins to crack with long, superficial cracks, at the distance of two or three inches from each other. On each side of a branch, in the bark, is an oblique cleft; the two meeting above the branch.

The recent shoots are large, of a deep green, or bronzed, or purplish brown color, channelled with two grooves running down from the base of each leaf, and closely set with prominent white or gray dots. The older shoots are of a darker color.

The leaves, which often come out in a diverging or radiant manner, are very long, from six to nine, and often ten or twelve inches, and one to two and a half or three inches wide, lance-shaped, tapering or rounded at base, ending in a very long point. The principal veins, which are regular, undivided and parallel, end in long, bent points, which are separated by large, curved indentations. They are green and polished above, and smooth and paler beneath, and are supported by stout footstalks, half an inch or an inch long. While quite young, they are covered with a glandular viscidity, but soon become smooth on both surfaces. On vigorous shoots from the stump, a pair of somewhat glutinous stipules, broad at base, and tapering to a point, defends the tender leaf, and continues,

bristling at right angles, to protect it, until the footstalk is longer than they, when they fall off.

The male flowers, which come out later than those of any other forest tree, are in large, spreading bunches of stiff catkins, as long as the leaves, of a yellowish green color, and conspicuous at a distance, like pale yellow rays, on the ends of the branches. They spring from the axil of the leaves, or are alternate, like the leaves, on the ends of the branches. The flowers are clustered in scattered groups, along the stalk of the catkin, and, when shedding their pollen, emit a strong, and rather unpleasant odor. The fertile flowers are in burs, in the axil of the upper leaves; or, more frequently, near the base of the uttermost stalks of the sterile flowers; they are single, or two, three or more, near each other. The burs are, at the time of flowering, about half an inch long, on short, stout stalks, and are invested with crowded leaves and prickles, then very tender.

The fruit is covered with a bur, completely invested with crowded, sharp, and stiff bristles, which are not easily handled with impunity. It opens, when mature, by four valves, more than half way down, and contains the nuts, from one to three in number, in a downy cup. The nuts are roundish-ovate, tapering to a point, smooth below, and of a chestnut brown, and covered with a tawny down towards the tip. When more than one are in the bur, their contiguous sides are flattened.

In October, the fruit of the chestnut forms a tuft of lively, yellowish green, on the end of the branches, a striking object among the darker foliage.

The chestnut tree is found on the banks of the Mousum river, in the county of York, in Maine, a little beyond the 43d parallel of latitude, and thence southward, as far as Florida, and in the Western States. It is found in every part of Massachusetts, but does not readily and abundantly ripen its fruit in the immediate neighborhood of the sea. In all other

parts, it yields, when growing in open woods and a sunny exposure, an abundance of sweet and delicious nuts. Botanists consider it of the same species as the sweet or Spanish chestnut of Europe. That tree was, originally, a native of Asia, and was introduced by the Greeks and Romans into the south of Europe, from which it has long since extended into the north and west. It was called *Castanea*, by the Greeks, from a town of that name in Pontus, whence they obtained it; and it gave its name to a town of Thessaly, to which it was early transplanted. It is probable that only the choicest varieties were propagated; and yet the fruit of most of the varieties now growing in Europe are not considered suitable food for man. Those which furnish so large a portion of the food of all classes in the southern countries of Europe, especially in Italy, and an important article of export, are cultivated varieties, with larger and sweeter nuts. This is an important fact. The nuts of the American tree are decidedly superior in flavor to most of those cultivated in Europe, but are much smaller, — hardly a fourth part the size of the larger ones. Size and improved quality are the consequence of cultivation. By selecting the most valuable varieties of our native trees, and improving them by the arts of culture, we may hereafter obtain fruit superior to any now known. The extraordinarily rapid growth of the chestnut tree will give great facilities for the improvement of the species; and the abundance of the harvest from trees affords another security against the failure incident to crops from bad seasons. The valuable varieties of the foreign tree may be introduced by grafting, or by planting. The grafts, or plants, of the most desirable kinds, may be readily imported from the nurseries of France and England; and they may be found already growing in Winship's and other nurseries in this State.

The wood of the chestnut is coarse-grained, the circles of growth being separated by numerous large pores, or rather tubes; but it is strong and elastic, and very durable, even

when exposed to alternations of dryness and moisture. It is, therefore, of great value for posts, which, when charred, will last more than twenty years; and for rails, in which form it will last half a century. It is also much used, as a substitute for oak and pine, in building; beams and joists, and other parts of the frame, made of it being almost imperishable; and, in Italy, it is often found in churches known to be more than six centuries old. It is used for shingles, but is less valuable for this purpose, on account of its warping when exposed to heat. It is extensively employed in the manufacture of furniture; and, of late, for doors and the other interior wood-work of houses; but, to be permanently beautiful, needs to have its pores carefully filled. In the frame-work of articles to be covered with veneers of mahogany or other ornamental wood, it stands better than any other native wood. The frames of bureaus and sofas, and the bottom and sides of drawers, are made of it. For these purposes much of it is brought into Boston from Worcester County. It has been sometimes used for hoops; but is so far inferior to hickory and oak, that it is never used when they can be had. Its specific gravity is .522.

It is ill adapted to use as fuel, except for closed fires, the air in its numerous pores causing it to snap disagreeably; its value, according to Bull, being as 52 to 100, compared with hickory. But it forms an excellent charcoal; the younger trees furnishing the best and heaviest. For this purpose Michaux recommends its cultivation in copses. Its vigorous growth, from the stump of a tree of any age, recommends it. Springing from the stump of a young tree, the shoots often make six or eight feet in a single year, and in the period of sixteen to twenty-five years they are fit to be cut.

"Chestnut copses," says Michaux, "are considered in France as the most valuable species of property; every seven years they are cut for hoops, and the largest branches serve for vine-props; at the end of fourteen years they furnish hoops for large tubs; and at the age of twenty-five years

they are proper for posts, and for light timber. Lands of a middling quality, which would not have produced a rent of more than four dollars an acre, in this way yield a mean annual revenue of from sixteen to twenty-four dollars."

The bark of the chestnut abounds in tannin and in coloring matter. It is therefore valuable to the tanner, and may be used by the dyer. With iron, the extract may form an exceedingly black ink. The wood seems to abound in tannin, and, if reduced to chips, it would probably be found of value in tanning leather.

A large number of chestnut trees, which had grown in the forest, of from thirty-six to fifty-one years' growth, and varying from thirty-four to forty-one inches in circumference, gave, when carefully measured, very nearly three-tenths of an inch for the annual growth in diameter for the first forty or forty-two years. The circles, taken all together, were very nearly uniform. On the whole, they were decidedly broader near the circumference, showing that these trees were still growing, and more rapidly than ever before. The circles of one which had fifty-one circles in thirty-six inches, were, nearest the centre, twelve within one inch. It had probably been much choked in its earliest growth by the surrounding trees. The two outer circles only were sap wood, and they were the broadest circles of all. In every instance save one, the inner circles were considerably the narrowest. The inference is, that, in the old forests, the chestnut grows less rapidly for the first ten or fifteen years, after which it continues to increase in rapidity of growth till it is upwards of forty-five or fifty years old. Growing from the stump, where the whole growth has been felled, it springs with excessive rapidity in the earlier years.

The chestnut tree is not only one of the most rapid growers, but it attains a great age. Some of the most remarkable trees of Europe are chestnut trees. On Mount Ætna is the famous *Castagno di cento cavalli* (of which we give a figure), so called from its having sheltered a hundred mounted cavaliers. Bry-

done found this, in 1770, two hundred and four feet in circumference; and it had the appearance of five distinct trees. A century before, when seen by Kircher, they were united, so that probably it had been one tree. The Tortworth chestnut, in England, was fifty-two feet in girth in 1820, when measured by Strutt. Near Sanserre, in France, is a tree of more than ten feet in diameter at six feet from the ground; it is supposed to be a thousand years old.

The circumstances of our country are not favorable to the existence of large trees. Few of them attain a great size in the forest, and in few places have the largest of the forest been left standing. An old tree is standing near Meeting-house Pond, in Westminster, which measured fifteen feet two inches in circumference at the ground, in 1839, but diminished rapidly, being but ten feet ten inches at four feet. Several remarkable trees were standing, in 1840, in the western part of Bolton. In July of that year, there was, on the land of Joseph Houghton, a tree which measured twenty-two feet eight inches at the surface, seventeen feet six inches at three feet, fifteen feet six inches at six feet. The trunk was undivided for twenty-four feet, where it put forth several large but short branches. Another measured nineteen feet eight inches at the surface, fifteen feet nine inches at three feet, and fourteen feet three inches at six; at nine or ten feet it threw out some large crooked branches, and then towered to eighty or ninety feet, with a magnificent, full, branchy head. In the near vicinity are many noble trees. One, a vigorous, well-branched tree, seventy or eighty feet high, measured, at the surface, at three and at six feet, twenty-two feet three inches, seventeen feet one inch, and fourteen feet ten and one-half inches. A second, which at six feet divided into two main trunks, seventy or eighty feet high, measured, in like manner, twenty-two feet six inches, seventeen feet one inch, and sixteen feet seven inches in circumference.

In the stump of a tree recently growing on the same land,

THE ÆTNA CHESTNUT TREE. *Castagno di cento cavalli.*

which measured four and one-half feet or fifty-four inches in diameter, one hundred and twenty circles were counted, indicating an annual growth of nine-twentieths of an inch. At the same rate, the largest of these trees may be a hundred and seventy or a hundred and eighty years old.

South-east of Monument Mountain, near the road leading to Sheffield, in a pasture, an old chestnut measured, in September, 1844, at the ground, thirty feet two inches in circumference; at two feet, twenty-four feet seven inches; at four, twenty-one feet. At sixteen feet, it throws out several large branches, which form a top of sixty feet across.

Such fine old trees as these, wherever found, ought to be spared. Nothing but the oak produces so superb an effect. An old chestnut throws out arms almost as strong as the oak, and its foliage forms as beautiful a mass and a thicker shade.

The chestnut flourishes on rocky hills, where there is no great depth of soil, on a surface difficult of tillage, and fit only for forest. Of the many acres of this description in various parts of the State, especially in the middle counties, it is to be hoped that a portion will be spared to this valuable and rapidly growing tree. A circumstance which gives additional value to this tree is, that the wood admits of a high polish, and beautiful furniture may be made of it.

The mode of cultivating the chestnut is similar to that for the oak. It is successfully raised from the nuts, which, whether they are to be sent to a distance, or to be reserved for eating, should be gathered in the sunshine and exposed several days to the direct rays of the sun. In gathering the fruit, it is important to be careful not to injure the smaller branches. The chestnut may also be grafted in any of the modes in use for other trees.

The dwarf chestnut, a native of the Southern States, bears the rigor of our winters, and forms a shrub six or eight feet high. It has a strong resemblance to the common chestnut, with leaves and fruit much smaller.

II. 4. THE HAZEL. *CORYLUS.* L.

The hazels are shrubs, or, in the single instance of the Constantinople hazel, *C. Colurna*, low trees, with alternate, entire leaves, common in the cooler zones of both hemispheres. The male flowers, which come out very early, are in slender, cylindrical, pendulous aments; the female, in bud-like clusters, bristling with the long, thread-like, colored stigmas. There is one species, with many varieties, cultivated in Europe; one small tree belonging to Turkey; one on the Amour; one, much like our own, in Istria; and two species native to this country, the common and the beaked hazel. The husk of the common hazel resembles a cap: whence its English name from the Saxon, *hæsle*, a cap; and also its botanical, from the Greek, *corys*, a helmet.

The hazels are readily propagated by sowing the nuts, by suckers, and by layers.

The American Hazel. *C. Americana.* Wangenheim.

The hazel is a small, branched shrub, from three to six feet high. The younger branches are gray and hairy, with green or red gland-bearing hairs, and afterwards become brown, lighter below, with orange or green dots; the stem is dark colored. The leaves are broad ovate, or elliptic, heart-shaped at base, acuminate, coarsely and irregularly somewhat doubly serrate, hairy and rough, at last nearly smooth above, pale and hairy, with fine hairs on the veins, veinlets, and axils beneath. The leaf-stalk is short, round, and covered with grandular hairs, which are scattered on the mid-rib, and sometimes on the larger veins beneath. Stipules broad at base, tapering to a point, sometimes toothed and cut, nearly as long as the footstalk.

The aments of the next year appear in the axils of the

leaves in August. In March or April, those on which the sterile flowers are arranged are found expanded into slender, cylindrical, tremulous catkins, two or three inches long, terminal, or dependent from lateral footstalks, single, or two to five together. They consist of deltoid, wedge-shaped, concave, pointed, hairy scales, pretty closely and imbricately arranged around a central thread, and each containing about eight anthers, attached by a short, minute thread, to a delicate, hairy membrane, with which it is lined, and which terminates in two scales, just below the edge of the outer one. These aments are of a grayish yellow, or fawn color, and hang gracefully on their stalks, moving with every wind, and spreading in the air their yellow pollen.

The fertile flowers are little star-like tufts of crimson stigmas, projecting above a short, scaly bud of numerous scales: the outer scales are broader, and edged with hair; the inner ones hairy, lanceolate, and fleshy. In the axil of the central scales are the stigmas, which are long and thread-like, and divided to their base. The inner scales increase in size with the nut, and become the husk; two or three scales, very much enlarged, enclosing it entirely, and forming a cap.

The nut is about three-fourths of an inch in breadth, and somewhat less in length, roundish, slightly compressed, with a bony shell of a light brown color, roughish at base, where it adheres, while immature, to its cap. This is an involucre of two broad leaves, much larger than the nut, green and fleshy, when young, inflated at base, covered with coarse, glandular hair, deeply and irregularly cut, fringed on the compressed border, and turning grayish brown when mature.

The hazel grows readily in dry or moist, light soil, by the sides of woods or walls. The fruit varies much in quality in different places. In taste, it is fully equal to the filbert, and by many persons it is preferred. The finest specimens of it are equal to the filbert in size. If these were selected and carefully cultivated, they would, as all other fruits have been

found to do with similar treatment, improve in quality. In England the filbert is much cultivated, and gives sometimes a very productive crop. Miller says that its qualities can only be preserved by propagating by suckers, or layers. The same methods might be used for our hazel. By selecting the largest, finest, and earliest nuts, sowing them in the most propitious soil, and selecting from those plants which soonest come to bearing the most promising nuts for seed, and thus constantly repeating the operation, the size, productiveness, and flavor of the fruit would, doubtless, be greatly improved. The improved varieties might be easily propagated by suckers, of which it is the nature of the hazel to throw out great numbers.

There are many road sides and borders of fields which might be planted with the hazel, from whence, with little expense, a desirable addition to the table might be raised, which children could be employed to gather. Hazel-gathering is, even now, in some parts of New England, a pleasant little festival for children; and the remembrance of the nooks among the woods, and the thickets along the river banks, to which the search for nuts leads, is not unwelcome in graver and busier years.

The common hazel is found from Canada to Florida, and throughout the Western States.

The plant is too small to be of much service, though it may possibly have as much virtue as the European species of which Evelyn writes: "The coals are used by painters to draw with, like those of sallow: lastly, for riding switches, and divinatory rods for the detecting and finding out of minerals; at least, *if that tradition be no imposture.*"

The Beaked Hazel. *C. Rostrata.* Aiton.

This is a somewhat smaller shrub than the common hazel, being from two to six feet in height, and it is of much less frequent occurrence. Yet there are few country towns in which

the boys are not acquainted with the taste of its nuts. The recent shoots are brown and smooth, sprinkled with a few gray dots. The older branches are rough and darker, and the stem a grayish brown. The leaves are on very short, nearly smooth footstalks, pear-shaped, narrowed towards the base, and heart-shaped, ending in a point, doubly and irregularly serrate, smooth above, somewhat downy or hairy beneath. The fertile flowers resemble the leaf-buds, with a few crimson, thread-like stigmas projecting from the upper scales. The sterile catkins are about an inch long, of a pale greenish yellow, single or in pairs, from the axils of leaves of the previous season. They are shorter, smaller, and of a purer yellow than the common hazel. The nut is small and roundish, enclosed in a bristly husk, which fits its shape at the base, but is lengthened into a jagged beak at the extremity, like a narrow, long-necked bottle. By this it is easily distinguished from the common hazel, as well as by the inferiority in the size and quality of the nuts. These grow on the ends of the branches, in bunches of two to eight or nine, most of which never come to perfection.

This is a Northern species. Dr. Richardson found it in Canada, as far north as the Saskatchawan. On the highest mountains of the Alleghany range, it occurs in the south-western part of the country.

Messrs. Prince, of Long Island, found that the European hazel grows perfectly well in our climate, a single bush annually producing half a bushel of filberts.

The Constantinople hazel is a tree of sometimes fifty or sixty feet in height.

FAMILY III. THE HORNBEAM FAMILY. *CARPINACEÆ.*

This family is nearly allied to the oak family, from which it is distinguished by having its female flowers arranged in a loose terminal ament, which becomes an open, pendulous, compound fruit, resembling a hop. The male flowers are on long, cylindrical, tassel-like aments, formed of simple, imbricate scales, with twelve or more stamens attached to the base of the scales.

It contains small trees, found in the temperate zone of both hemispheres, remarkable for the solidity, strength, and toughness of their wood; with annual, alternate, simple, entire leaves. The buds are covered with imbricate scales, investing and separating the plaited leaves.

It comprehends two genera of trees found here: The Hornbeam, with its naked nut concealed in the axil of a leaf-like bract; and

The Hop-Hornbeam, whose nut is covered by a hairy, inflated, membranous sack.

III. 1. THE HORNBEAM. *CARPINUS.* L.

Small trees, with a smooth, fluted, or irregular trunk, and alternate, entire leaves. The female flowers are in loose aments, made of small, scale-like, changed leaves, in pairs. These, enlarged, contain the fruit, which is a small, ribbed, bony nut in the angle of a changed, halbert-shaped, or three-lobed leaf. There are about six species, one of which only is found in New England.

THE AMERICAN HORNBEAM. *C. Americana.* Michaux.

Figured in Michaux; Sylva, Plate 108. Loudon, Encyc. 918.

The hornbeam is a small tree, easily distinguished by its trunk, which is marked with longitudinal, irregular ridges,

HORNBEAM. *Carpinus betulus.*

AMERICAN HORNBEAM. (Carpinus americana.)

resembling those on the horns of animals of the deer kind. From its great resemblance to the European species, it received at once, from the earliest settlers, this good old English descriptive name.[1] The bark is smooth, like that of a beech, and of a dark bluish gray or slate color, whence it is sometimes called the blue beech.

The trunk is a short, irregular pillar, not unlike the massive reeded columns of Egyptian architecture, with projecting ridges which run down from each side of the lower branches. The branches are irregular, waving or crooked, going out at various but large angles, and usually from a low point on the trunk. The recent shoots are very slender and tapering, somewhat hairy, and brownish or purple. The older branchlets are of a dark ashen gray, with a pearly lustre.

The leaves are very much like those of the black birch. They are on short footstalks, elliptical or oblong, two to three inches long, and one to one and one-half broad, rounded at the base, sharply and unequally serrate, smooth, and slightly impressed at the veins above, paler and softly hairy along the veins, and with a prominent tuft of hair at the axil of the veins beneath. The footstalk is a little hairy; the buds oval. The autumn colors of the leaves are different shades of scarlet and crimson.

The male catkins come out before the leaves, on the sides of the branches. They are an inch, or usually less than an inch long, and look as if they had been stunted in their growth. They are set with broad-ovate, pointed scales, within which are twelve or more anthers, resting by their base on short filaments. The female catkins come out of the same bud with the leaves, at the ends of the smaller branches, so

[1] Gerard thought otherwise in regard to the derivation of this name. He says, of the corresponding English species, "The wood or timber is better for arrowes and shafts, pulleyes for mils, and such like devices, than elme or wichhazell; for, in time, it waxeth so hard, that the toughness and hardness of it may be rather compared to horn than unto wood; and therefore it was called hornebeam or hardbeam." — *Herball*, p. 1479.

that the fruit is in clusters terminating a short, leafy branchlet. When mature, the compound fruit-heads are on very slender footstalks of from one to two-thirds their length, and consist of a series of alternate pairs of transformed, sagittate leaves, growing together at base, and forming each a cup enclosing an egg-shaped, eight-sided nut, in a thin, dark brown, ribbed husk, crowned with the stigma. The nut is flattened on one side, of a woody texture, and contains a small kernel which tastes somewhat like a chestnut.

When growing by itself, in open ground, the hornbeam is a low tree, with a broad, round, crowded, leafy head, the lower branches bending nearly to the ground on every side. Its general aspect and figure are like those of the beech, and it is more uniform in its appearance than any other tree.

It is found in every part of the State, and in almost every variety of soil except the most barren; but flourishes only in rich, moist land. It is never a large tree. I measured one by the side of the Agawam River, near Chester Village, which was three feet nine inches in circumference above the bulging of the roots, and about thirty feet high; one in Brookline measured two feet six inches at two feet from the ground; and I have often seen it of similar dimensions. It is usually five or six inches in diameter, and about twenty feet high. From the situations in which it is commonly found growing, on the steep sides of river banks, and cold, clayey hills, it is rarely erect, but generally inclined obliquely upwards, with very large, spreading branches.

It is of slow growth, and is supposed to live to a great age. The wood is white, close-grained, and compact, and has great strength. It is used for beetles, levers, and for other purposes where strength and solidity are required; and it is well fitted for the use of the turner. The corresponding species in Europe, a very much larger and taller tree, and continuing to grow in Italy for two hundred years, on any kind of soil, is much esteemed as fuel; and in France its charcoal is preferred

AMERICAN HOP HORNBEAM. (Ostrya Virginica.)

to most others. The hornbeam is a tree of considerable beauty. Its smooth, fluted trunk is an interesting object to one curious in forest history; its foliage is remarkable for its softness, and the fruit is unlike that of every other tree. The crimson, scarlet, and orange of its autumnal colors, mingling into a rich purplish red, as seen at a distance, make it rank in splendor almost with the tupelo and the scarlet oak. It is easily cultivated, and should have a corner in every collection of trees.

According to Michaux, this tree is found in Nova Scotia, and Pursh found it in Florida. It is common in all the New England States, in New York and Pennsylvania, and in Carolina and Georgia.

2. THE HOP HORNBEAM. *OSTRYA.* L.

To this genus belong low trees or shrubs of the temperate zones, in both hemispheres. The sterile flowers are in cylindrical, pendent aments; the fertile, in short, slender aments, which, when mature, have a striking resemblance to a hop, and are made up of inflated sacks containing a brown nut. There are few species, of which one is a native of the south of Europe, and one only of this country.

The American Hop Hornbeam. *O. Virginica.* Willdenow.

Figured in Michaux; Sylva, Plate 109; in Abbot's Insects, II., Plate 76; and poorly in Audubon's Birds, Plate 40.

The hop hornbeam is a handsome, small, slender tree, easily distinguished when in fruit by the resemblance of its spike of seed-vessels to a hop. The leaves are similar to those of the black birch, and of the hornbeam, from the former of which they may be distinguished by the absence of the chequerberry taste, and from the latter, by being more elliptical. The twigs are distinguished from both by their extreme toughness. The bark on the trunk is dark grayish, and is remarka-

ble for being divided into very fine portions, three or four inches long, easily scaling off, narrower than the divisions on any other rough-barked tree, and continuing to become finer and narrower as the tree grows older.

The branches are rather small, long, and slender, and make a large angle with the stem, forming an open head. The bark on the younger ones is smooth, and of a reddish copper or bronze or dark purplish brown color, like the cherry tree, dotted with white or gray. These dots lengthen horizontally, as on the bark of the birch; and the smoothness and deep color continue till the branch or stem is two or three inches thick, when the bark begins to crack and become grayish.

The recent shoots are very slender, of a reddish green dotted with brown; the older shoots are small and tapering, giving, with the leaves expanding in the same plane, great softness of appearance to one of the toughest trunks of the woods.

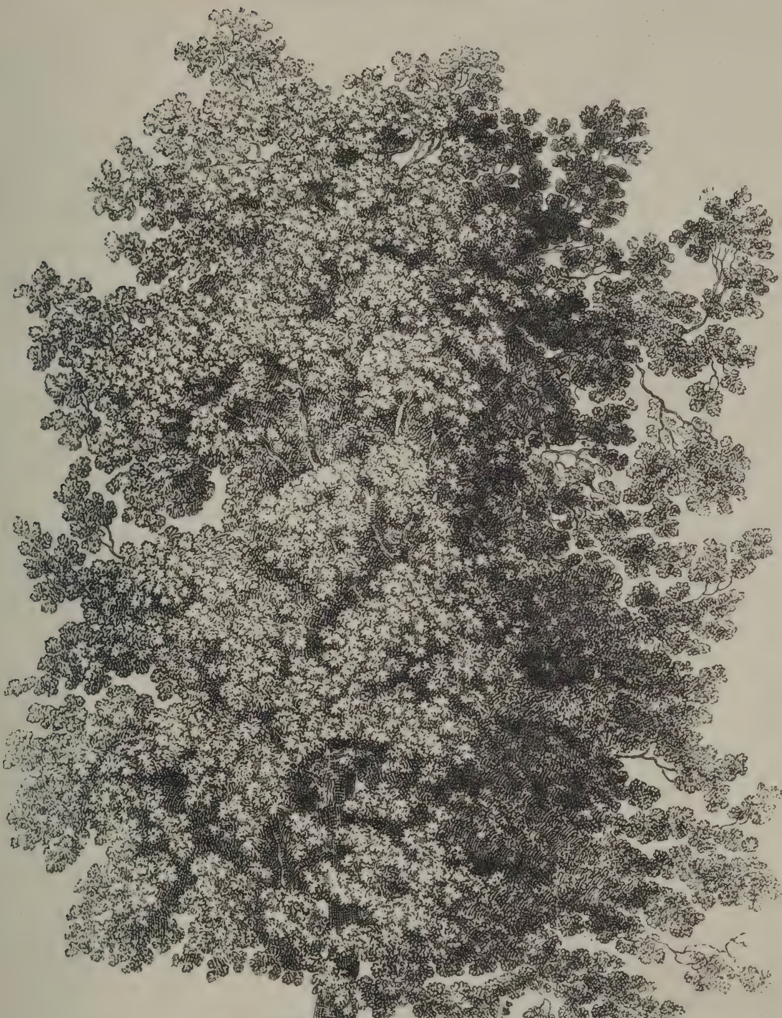
The leaves are three or four inches long, and two wide, oblong ovate, or elliptical, heart-shaped at base, beautifully tapering to a long point, unequally and sharply serrate, smooth above, paler and somewhat hairy, particularly at the axils and along the veins, beneath, thin, of a delicate texture, and sitting on very short, often hairy footstalks. In autumn, the leaves assume various shades of orange brown, or yellowish brown, and russet.

The barren flowers, which expand in May, at the same time with the leaves, or just before, are in cylindrical, pendulous catkins, one or two inches long, of a tawny, brown, or purple color, at the ends of the twigs of the last year. The scales of which they are formed are very short, broad ovate, acuminate, thickly ciliate, and hairy at the base within. The stamens are twelve or more, one-celled, bearded at tip, resting, near their base, on short, irregularly branched, hair-like filaments.

The fertile flowers come from the same bud with the leaves, so that they are at last at the end of a leafy branch. This

Óstrya vulgàris.

The common Hop Hornbeam.



Full-grown tree at Kew, 66 ft. high; diam. of the trunk, 3 ft.; and of the head, 51 ft.
[Scale 1 in. to 12 ft.]

HOP HORNBEAM. *Ostrya vulgaris.*

bud is enclosed by several scales, and each leaf, plaited and folded together within, has at its base a pair of thin, pointed, striate, stipular scales, which soon fall. The leaves and the minute branches are invested with bristle-like hairs. Above the leaves are the slender catkins, half an inch long, made up of very hairy, long, pointed scales, which soon fall off. Within them are the smaller but more permanent scales which protect the future fruit. Several of the lower ones contain nothing. The upper ones protect each two sacks, conical at base, and ending in cylindrical, hairy tubes, from which project the two hair-like, purple or red stigmas, surmounting the enclosed ovary. At the period of the bursting of the anthers, the female catkin is three or four tenths of an inch in length. This rapidly enlarges, and, at maturity, is an inch or sometimes two or three inches long, and of half that width. This compound fruit is a collection of follicles, resembling a hop, erect, finally pendulous, on a club-shaped, hairy stalk of the same length, terminating the branchlets, and a conspicuous ornament in July and after. The seed-vessels, to the number of twelve to twenty, are aggregated in pairs. Each is an ovate, flattened, membranaceous, veined, inflated, sessile sack, half an inch long, terminating in a point, and set at base with numerous, needle-like, stinging hairs, and containing at the base a dark brown nut of nearly the same shape, three or four lines long, free, except at base, where it adheres to the sack.

The wood of the hop hornbeam is close-grained and compact, and remarkably tough and stiff; on account of which properties, it is often used to make levers, and is called *lever-wood*. It is also called *iron-wood*, from its extreme hardness, and is well adapted to make cogs in mill-wheels. It is suitable for stakes of carts, for binding-poles, and for all similar uses.

This tree seldom grows to a large size. I measured one in Roxbury, near the railroad, where it occurs abundantly, which

was three feet two inches in girth at the ground, two feet six inches at four feet, two feet eight inches at five and one-half feet. On the road leading from Pittsfield to Williamstown, in Lanesborough or beyond, in a field on the right, I measured, in September, 1838, one which had a circumference of five feet and eleven inches at the ground, and another of four feet nine inches.

In Bristol County, this tree is sometimes called black hazel, and Indian cedar.

Dr. Richardson found the hop hornbeam in Canada, as far north as Lake Winnipeg. Michaux found it in New Brunswick and Nova Scotia. It occurs in all the New England States; in New York; in Pennsylvania; and in Carolina and Georgia.

WALNUT. *Juglan regia.*

FAMILY IV. THE WALNUT FAMILY. *JUGLANDACEÆ.* De Candolle.

The plants belonging to this family are lofty timber trees, found native in the northern temperate regions of both continents. They are distinguished for their compound, pinnate leaves, exhaling an aromatic odor when crushed; the barren flowers borne on simple or compound pendulous catkins; the fertile, in a small terminal group, or solitary. There are few genera: one common to Europe and this country, one peculiar to this country, and a few others more recently and less perfectly known.

The kernels of several of the species are sweet and wholesome, abounding in oil. The rind of the English walnut is extremely astringent; the rind and the bark of the butternut possess cathartic properties; and the husk and bark of both species of American walnut, and of several of the hickories, may be used in dyeing. The wood of all is highly valuable as timber.

De Candolle describes five well known species of the walnut: one, the European walnut, with fifteen varieties; three American; and one Asiatic. One of the American is found in California.

Insects on the Walnuts and Hickories. — The caterpillar of the beautiful *Luna* moth (*Attacus Luna;* Harris's Report, p. 382) feeds on the leaves of the hickories and walnuts. So does a species of the *Limacodes*, or slug-caterpillars (ib. p. 419); and so does the goldsmith beetle, *Areoda lanigera* (ib. p. 25). Swarms of caterpillars of one or perhaps several species of *Pygæra* are found on the same trees (ib. p. 431). The smaller limbs of the pignut hickory are found, during July, covered on their lower surface by clusters of the *Aphis caryæ* (ib. p. 238),

which suck their sap; and the bark and wood of this tree are bored, sometimes very extensively, by the larvæ of a Buprestian beetle (ib. p. 49). Grubs of the *Apate basillaris* sometimes destroy the shellbark by boring to its heart, where they undergo their transformation (ib. p. 92). The caterpillar of the walnut sphinx (*Smerinthus juglandis*), feeds on the leaves of the black walnut and the butternut (ib. p. 328); and the most magnificent of the American moths, called by Dr. Harris the regal walnut moth, *Ceratocampa regalis*, feeds on the leaves of the black walnut (ib. p. 399).

The two American genera of the Walnut Family are the Walnut and the Hickory.

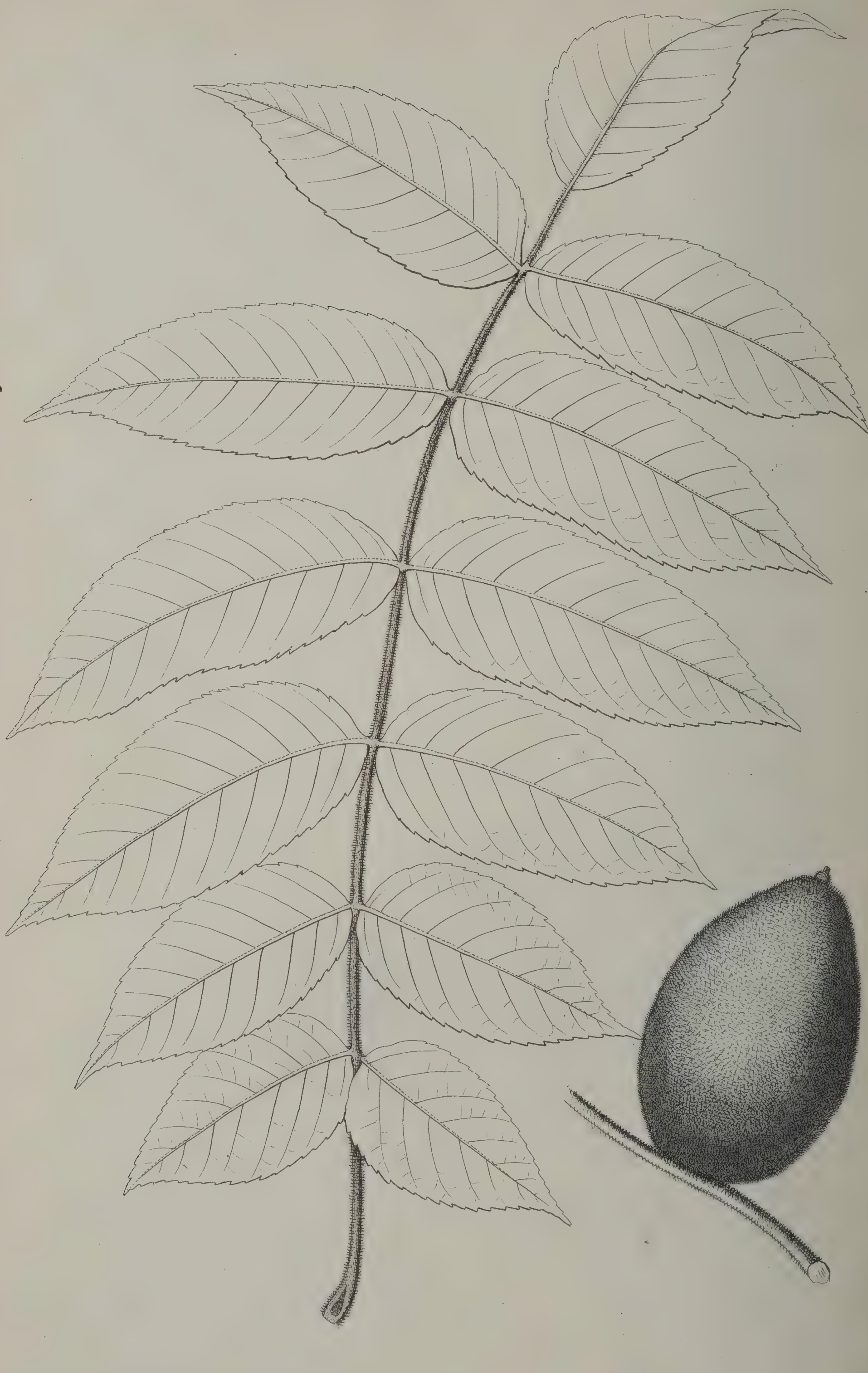
1. The Walnut has its flowers in simple, undivided aments; its fruit covered by an undivided husk; and its leaves made up of very many leaflets, — from eleven to twenty-three.

2. The Hickory has its sterile flowers in compound aments, the husk of its fruit opening naturally by four seams; and its leaves of fewer leaflets, — from five to nine.

I. THE WALNUT. *JUGLANS.* L.

Spreading, round-headed timber trees, natives of North America and Persia, with rough bark, and deciduous, aromatic, compound leaves, made up of many leaflets; as many, usually, as from five to eleven pairs with an odd one. The sterile flowers are in large, undivided catkins, from buds distinct from the leaf buds, each flower containing from eight to thirty-six stamens; the fertile are solitary, or in small groups at the end of the branches. The fruit is large, and covered with a spongy, odorous, undivided husk.

Before the introduction of the mahogany into Europe, the wood of the European walnut, which is a majestic tree, was much employed in the making of furniture. Its chief use



BUTTERNUT. (*Juglans cinerea.*)

now is for gun-stalks. The kernels of the walnuts abound in oil, which is prone to become rancid, either in the kernel or when expressed, and is then unwholesome. Properly dried, the nuts are sweet, wholesome, and nutritious. The expressed oil is not congealed by cold, and, drying on exposure to air, it is useful in painting. It is also used in cookery, as a substitute for the olive and almond oils. The nut-bread, left after the expressure of the oil, is nutritious, and is used to fatten poultry and other domestic animals. The bark of the several species is bitter and astringent, and has been recommended in fevers, and to give tone and strength to the stomach. The sap abounds in sugar, which crystallizes on evaporation, like that of the sugar-cane. Fermented, the sap affords an intoxicating liquor, called walnut wine.[1] The tree grows best, tall and straight, from nuts planted where it is to stand. It grows rapidly for forty or fifty years, but continues to enlarge till eighty.

There are two species found native in New England: —

1. The Butternut, known by its long, ovate fruit, covered with clammy hairs, and
2. The Black Walnut, whose fruit is nearly round, not hairy, but slightly rough with granular points.

Sp. 1. The Butternut or Oil Nut Tree. *Juglans cinerea.* L.

Figured in Bigelow's Medical Botany, Plate 32; in Michaux; Sylva, Plate 31; and in Audubon's Birds of America, Plate 142; Encyc. 735; and our Plate.

A low, broad-headed tree, rising to the height of thirty or forty feet, and spreading to a considerable distance on every side. Even in the forest it shows little disposition to soar to a great height. The recent shoots are of a light greenish gray,

[1] *Burnett's Outlines,* II., p. 528.

downy, soon becoming of a clear light gray, obscurely dotted. The branchlets of last year are stout, smooth, of an ashen brown, with gray dots, the scar of the leaf conspicuous and large. The branches are horizontal, or slightly inclining upwards, very long, irregular, with a gray bark, soon cracking and growing rough with grayish, superficial rifts, the lenticular dots, long and lighter-colored; on the very large branches the prominent rugosities often cross each other diagonally, cutting the surface into lozenges, or the clefts separate, widening into diamonds; while the trunk, covered with a dark, granite gray bark, is rough, with clefts not running into each other. The leaves are compound, twelve to eighteen inches long, with from three to seven, rarely eight, pairs of sessile leaflets, and an odd one which is supported on a prolonged footstalk. The common footstalk is stout at base, tapering, rounded or angular, or often flattened horizontally below the leaves, and vertically between them, very downy, as is the lower surface of the leaves. The leaflets are from two to four inches long, and somewhat less than half as wide, lance-ovate, rounded at base, gradually tapering to a prolonged point, serrate, rather thick and rough, and lighter colored beneath. The buds are destitute of external scales.

The sterile flowers issue from the sides of last year's shoots, in large green catkins four to seven inches long, and four or five eighths of an inch or more in diameter. They are on oblong, shield-like, green scales, disposed pretty closely on all sides of the catkins. Each scale terminates in a brown, hairy tuft, above which are three lanceolate, pointed lobes, with two lateral lobes midway of the scale. The stamens are about eight to twelve, sessile, brown on the upper surface, which, by the pendence of the catkins, becomes the lower.

Fertile flowers, two, six, or seven on a terminal downy stalk. Each is surrounded by an involucre of several broad scales, forming at base the oblong cup, and within them are five or six narrow, pointed sepals, immediately investing the long

style, which terminates in a large purple or rose-red stigma, deeply cleft, two to three eighths of an inch long. The cup, which enlarges to become the fruit, is invested with numerous reddish or white glands, which exude a penetrating, viscid substance.

The leaf-stalks and recent shoots are set with similar glands, in less number.

The flowers appear in May, and the fruit ripens in October.

The fruit grows single, or two to five together, on the sides and end of a stout, pliable footstalk, which is one to three inches long. They are green, turning to brown, oblong-ovoid, or inversely pear-shaped, invested with glandular hairs, which secrete a clammy, resinous, and penetrating odorous substance, and crowned by the stigma and ends of the calyx scales. Within a thin, leathery husk, they contain a nut about two inches long, and of half that thickness, covered with stony, opposite, keel-like projections, and sculptured with deep furrows and sharp, irregular ridges. It is rounded at base, and acute at the end, and about an inch in diameter. The kernel of this nut is of one piece, but can with difficulty be extracted whole. It is of an oily nature, and soon becomes rancid; but when carefully dried is sweet and very pleasant.

The butternut tree abounds on the Hoosic Mountains, among the Green Mountains, on the sides of the Wachusett, and particularly in the Connecticut valley, where it attains a very large size. It is of very rapid growth when young.

From the bark of this tree an extract is made, which is sometimes employed as a medicine, and is valued as a safe purgative, peculiarly mild in its operation. The bark and the nut-shells are used to give a brown color to wool. The Shakers at Lebanon dye a rich purple with it. Bancroft says that the husks of the shells of the butternut and black walnut, may be employed in dyeing a fawn color, even without mordants. By means of them, however, greater brightness and durability are given to the color. The bark of the trunk gives a black,

that of the root a fawn color, but less powerfully. From the sap an inferior sugar has been obtained. The leaves, which abound in acrid matter, have been used, in the form of powder, as a substitute for Spanish flies.

The young, half-grown nuts, gathered early in June, make excellent pickles, and are much used for that purpose, the clammy down being removed, before pickling, by plunging them in boiling water and rubbing with a coarse cloth.

The wood is light, of a pale reddish color, of little strength, but durable when exposed to heat and moisture, rather tough, and not liable to the attacks of worms. For gun-stocks, it is equally stiff, elastic, and tough with black walnut, but less hard.

It makes beautiful fronts of drawers, as used by the Shakers at Lebanon, and excellent light, tough, and durable wooden bowls. In the western part of the State, coffins are often made of it. Where abundant, it is used for posts and rails, and for the smaller timbers in house frames. It is sometimes used for the panels of coaches and other carriages, being pliable, not splitting when nails are driven into it, and, from its porosity, receiving paint extremely well.

Michaux says that the butternut is found in Upper and Lower Canada, on the shores of Lake Erie, in the States of Kentucky and Tennessee, and on the banks of the Missouri. It occurs in all the New England States, and in New York and Pennsylvania.

In Richmond, I measured a butternut tree which was thirteen feet and three inches in circumference in the smallest place below the branches. I have found trees of nearly similar dimensions in many parts of the State, and much larger ones on the Connecticut River.

BLACK WALNUT. *Juglans nigra.*
Near W. C. BRYANT'S, Roslyn.

Sp. 2. The Black Walnut. *J. nigra.* L.

Figured in Catesby, Plate 67; in Michaux, Sylva, I., Plate 30; and in Audubon s Birds of America, II., Plate 156; Encyc. 734; Du Hamel, 4, 48; and our Plate.

A fine tree with spreading branches and a broad round head. The bark is rough and furrowed, and darker than that of the butternut tree.

The leaves have from six to ten pairs of leaflets and an odd one. They differ from those of the butternut by being smooth above, while those of the butternut are rough; in having the leaf-stalk smooth, the leaves more smooth on both surfaces, more strongly serrated, less sessile, and a little more pointed, with the leaf-stalk less swollen, and the buds smaller. The fruit is round, and on a short footstalk; that of the butternut, long, ovate, and on a long footstalk.

It is found in Massachusetts, but comes to its greatest perfection, and displays its fullest proportions, in the States on the Ohio. On the banks and islands of that river, Michaux says he has often seen trees three or four feet in diameter, and sixty or seventy feet in height, and that it is not rare to find them of the thickness of six or seven feet. "When it stands insulated, its branches, extending themselves horizontally to a great distance, spread into a spacious head, which gives it a very majestic appearance." As it is found growing with us, it is remarkable rather for beauty than for majesty; yet if the flourishing young trees which are now to be seen are allowed to increase for a century, they will probably merit the encomium bestowed by Michaux.

The sterile flowers are loosely set on green, simple catkins, from four to seven inches long, dependent from the axil of the last year's leaves. Stamens very numerous, twenty to thirty or more, green, short, sessile, close set within a nearly circular perianth of six rounded lobes. The fertile flowers are sessile on a terminal common footstalk, an inch or more long. Each

cup is surmounted by a many-toothed circle, or involucre, within which are four slender, lanceolate lobes, encircling the style with its long, deeply bifid, purple or red stigma. Recent shoots slightly downy or powdery, as are the leaf-stalks.

The leaves are very long, with from fifteen to twenty-one leaflets; the leaf-stalk downy; leaflets on a short petiole, nearly smooth, downy on the mid-rib above and beneath, ovate-lanceolate, with a long acumination, inequilateral at base, lower ones cordate, middle ones rounded, upper ones acute below, and serrate.

Recent branchlets very downy; fruit-stalk somewhat downy. Fruit globose, nearly smooth, or somewhat granulate, and of a greenish yellow when mature, but soon turning to a dark brown. Within the spongy husk is a rough, deeply furrowed nut, round, but slightly flattened, with a woody or bony covering. The kernel, which nearly resembles that of an English walnut in shape, is more oily, but, when carefully dried, of a rich and very agreeable taste.

The wood of the black walnut is of a dark violet, or purple color, becoming deeper and almost black with age. It is valuable for its fineness of grain, tenacity, hardness, strength, and durability. These qualities, together with its beauty and toughness, render it preferable to any other material for the stocks of muskets. The wood is beautifully shaded, and admits of a fine polish, and it is now very extensively used in the manufacture of tables, chairs, bureaus, bedsteads, and other cabinet work; and sometimes for book-shelves, and the cornices and panels of rooms. Where abundant, it serves the same useful ends that hickory does with us. Posts made of it last for more than a quarter of a century. It is brought into the State in considerable quantities for the purposes above mentioned. More nearly than any other American tree, it resembles the European walnut, which, before the introduction of mahogany, was considered the most beautiful material known for the best kinds of furniture.

Its erect stem, and the breadth of shade from its abundant, soft and luxurious foliage, recommend it as an ornamental shade tree. It is perfectly adapted to our climate. It is found growing naturally in small numbers, or solitary, in several parts of this State, and it has been successfully cultivated in many others. An individual tree in the Botanic Garden at Cambridge measures six feet three inches at three feet from the ground. Its growth from the seed is certain and rapid. Its rich, oily fruit, when carefully dried, is nearly equal to that of the shagbark hickory. From the kernel a valuable and abundant oil may be expressed, superior to most others for use in cookery, and for lamps. Bread has also been made from the kernels. The spongy husk of the nuts is used as a dye-stuff. It thus unites almost all the qualities desirable in a tree: beauty, gracefulness, and richness of foliage, in every period of its growth; bark and husks which may be employed in an important art; fruit valuable as food; wood unsurpassed in durability for use, or in elegance for ornament.

IV. 2. THE HICKORY. *CARYA.* Nuttall.

The hickories are valuable timber trees, with large com pound leaves, having from five to fifteen, but usually not more than eleven, leaflets. The sterile flowers are in compound catkins, each principal catkin having two opposite branches; the stamens, from four to eight in each flower. The fertile flowers are solitary, or in small groups, at the end of the branches. The fruit is a large, roundish nut, the husk of which opens partially or wholly, of itself, by four seams.

The hickory is peculiar to America. The nearest approach to it on the Eastern Continent is in the European walnut. In many respects, it is amongst the most valuable of our trees. It is always a stately and elegant tree; and the several species, and individuals in the same species, exhibit so great a variety

of appearance and foliage that they have almost the interest of a forest. Few trees contribute so much to the beauty of the woods in autumn. The colors of all at that season are rich, and each species has its own. The smoothness, closeness, and hardness of the grain of the wood give it great value in the arts; and for fuel it holds unquestionably the first place. The fruit of some of the species, even in the unimproved condition of its forest state, vies with the best of foreign nuts, and is destined, doubtless, to be greatly improved by the resources of cultivation. With such claims, it has a right to demand more attention than it has yet received.

From the great resemblance which several of the species have to each other in shape, and in the size, form, and number of the leaflets, they are liable to be confounded; and distinct species are confounded almost universally. Except when in fruit, it is very difficult to distinguish them; and even then it is necessary for the inexperienced observer to have recourse to the taste, so great and numerous are the diversities in their size, shape, and external appearance. The hickories are stately trees. All of them have, more than any other native deciduous tree, a tendency, even when growing by themselves on the open plain, to rise to a great height, and form a tall cylindrical head, not wide, but holding a breadth of twenty or thirty feet, with only such breaks and irregularities as preserve it from sameness, to the very top, This is a great beauty, and serves to give a marked character to the tree when seen at a distance, left, as it often is by our farmers, an ornament and shade to the pasture, or standing by itself on the edge of a wood, or along enclosures. This great beauty of the tree would recommend it for trânsplantation to the sides of commons and public roads, if it were not for the great difficulty with which it is removed after it has attained any considerable height. The principal root, except, perhaps, in the case of the bitternut hickory, is a very long and perpendicular taproot, with few fibres or side roots. It is therefore liable to be so much injured

in transplanting, from the loss of the extremity, that few trees survive the operation. To be successfully propagated, it must therefore be raised from the seed, sown where the tree is finally to remain. In our bleak and windy climate, few trees will grow without shelter in their earlier years. The hickories should be raised in large masses, of several acres at least. And the nuts, previously made to germinate in boxes, filled with earth and kept moist in the cellar,[1] should be sown so plentifully as to allow for casualties, such as the depredations of squirrels and other small animals, and still remain growing pretty thickly. Their growth at first is slow, but it is more rapid in proportion to the completeness of their protection on every side. When the young plants have attained the height of from five to eight feet, they may be thinned out for the purpose of making walking-sticks, for which the consumption is very considerable, and the demand constantly increasing. When at the height of fifteen or twenty feet, and from two to four inches in diameter, they may be still further thinned for hoops. The value of the young and growing trees for fuel will be a sufficient inducement to continue the operation of thinning to as great a degree as is necessary for the best growth of the larger trees, which may be left standing for timber, for ornament, or for the fruit. Hickories managed in this way, drawn up at first by being surrounded by other trees, and afterwards gradually exposed to the action of the sun and air, will have their peculiar beauties developed in the fullest manner. It is merely an imitation, by art, of the mode by which some of the best trees of this kind now standing have been formed.

The uses to which hickory wood is put are very numerous. Great numbers of walking-sticks are made of it, as for this purpose no other native wood equals it in beauty and strength. It is next in value to white oak, for making hoops, of which

[1] Michaux, *N. A. Sylva*, I., p. 205. He adds, "The success of this simple method is certain."

great quantities are made in the State, and many more imported. The price these bring is such that it is doubtful whether land of a suitable quality can in any other way be made so productive as in raising them. Hickory makes the best screws, the smoothest and most durable handles for chisels, augers, gimlets, axes, and many other common tools. Seasoned wood of some varieties of the pignut and mockernut trees, is equal in durability to iron wood or lignumvitæ, for mallets and heads of beetles, being tougher and more durable than white oak. The sailor prefers a hickory handspike. Its smoothness and tenacity recommend it for the screws of presses, the rings which confine the sails of small vessels to the mast, and for the cogs of grist-mills. The carriage maker employs it for the springs of gigs, the whiffle-trees of stage coaches, and the shafts of light wagons. The farmer makes of it the teeth of his rakes, bows for his yokes, and handles for his axes; uses it, when white or yellow oak cannot be readily found, for axle-trees, saws it into planks for barn-floors, and applies it to many other purposes. For tide mills it is preferable to oak timber, as it is not attacked by worms when in salt water.

Its defects are that it shrinks much and irregularly, and therefore warps, that it is liable to the attacks of worms, and decays rapidly when exposed to moisture. As is the case with most other woods, that is most valuable which has grown most rapidly, and which, in consequence, has least of the red heartwood. That of the pignut is heaviest, next in succession the shellbark and mockernut, in the proportion, when green, of 31, 29, and 25.

As fuel, hickory is preferred to every other wood, burning freely even when green, making a pleasant, brilliant fire, and throwing out great heat. Charcoal made from it is heavier than that from any other wood, but it is not considered more valuable than that of birch or alder. The ashes of the hickories abound in alkali, and are considered better for the pur-

SHELLBARK HICKORY (*Carya alba.*)

pose of making soap than any other of the native woods, being next to those of the apple tree.

The shellbark hickory ought to be cultivated for its nuts. These differ exceedingly in different soils and situations, and often on individual trees growing in immediate proximity. There is a common idea, which seems to be well founded, that the excellence of the nut is proportioned to the roughness of the bark. An observation of the elder Michaux encourages us to hope that the fruit may be greatly improved by cultivation. He says that the fruit of the common European walnut, in its natural state, is harder than that of the pecanenut, and inferior to it in size and quality.[1]

The species of hickory common in Massachusetts, are four:—

1. The Shellbark, with five large leaflets, a large nut, of which the husk is deeply grooved at the seams, and with a rough, scaly trunk;

2. The Mockernut, with seven or nine leaflets, a hard, thick-shelled nut, and leaflets and twigs very downy when young, and strongly odorous;

3. The Pignut, with three, five, or seven narrow leaflets, small, thin-shelled fruit, and a pretty hard nut; and

4. The Bitternut, with seven, nine, or eleven small, narrow, serrated leaves, small fruit, with long, prominent seams, bitter and thin-shelled nut, and very yellow buds.

Sp. 1. Shellbark Hickory. *Carya alba*. A. Michaux.

Leaf, fruit, and female ament figured in Michaux; Sylva, I., Plate 36; and in our Plate in this volume.

This tree is almost everywhere in Massachusetts known by the descriptive name of the shagbark, or shellbark, a name likely to be retained. It is the only one of the hickories which is not constantly confounded with some other. It may

[1] *N. A. Sylva*, I., p. 137.

be readily distinguished by the shaggy bark of its trunk, the excellence of its globular fruit, its leaves, which are large, and have five leaflets, and by its ovate, half-covered buds.

The shellbark hickory is found in the county of York, in Maine, twenty-five miles east of Portsmouth, N. H. This is the most northerly point at which I have observed it, and there it is rare, and a small tree, but matures fruit of a fine quality. It occurs thence southward through the Middle and Southern States, as far as Carolina, and is found in the Western States.

It flourishes in nearly every part of Massachusetts, except the south-eastern counties. In the maritime districts, and in sandy soils, it is rarely found. It is most abundant in the neighborhood of Boston, and in Middlesex, Essex, and Worcester counties.

It grows best in a rich, moist soil, and produces its fruit most abundantly when growing by itself on the border of cultivated land, or on the edge of a forest. In such situations, a single tree sometimes bears several bushels of nuts.

The shellbark is a tall and stately tree, rising sometimes to the height of seventy or eighty feet, with a diameter seldom exceeding two feet. The branches are irregular and scattered, often numerous, but not large; and where the tree is left standing, after the other trees of the forest in which it had attained its height have been felled, it has a long and shapely, cylindrical head, of great beauty. Where it has grown almost by itself, from an early age, it often becomes a spreading tree, with a fine broad, but somewhat open, head. In the forest, its rugged trunk may be seen stretching up, with scarcely perceptible diminution, and without a limb, to a height of fifty or sixty feet. It is covered with a bark of remarkable and characteristic appearance. It is of a dark granite or ashen gray, and by a few distant, deep furrows, the external portion is separated into long plates, which cleave nearly off in large loose flakes, attached only by the centre or one end. This

singular exfoliation of the bark does not occur in very young trees, and we sometimes find them bearing fruit with a bark almost as smooth as the mockernut or the pignut hickory.

The branches, if compared with those of most other trees, are small, but are larger than those of the other hickories. The recent shoots are stout, at first grayish or greenish brown, afterwards purple, smooth, and dotted with numerous long, light-brown dots, obliterated in the older shoots, which become of a very dark gray. The leaves are large, and of five leaflets, of which the side ones are inequilateral, and nearly sessile, while the terminal leaflet is on a short footstalk. The lower pair are small, narrow, ovate lance-shaped; the upper pair and the terminal one very large and broad, and inversely egg-shaped. All end in a long point, and are coarsely serrate, smooth and dark green above, of a yellowish green and downy beneath, on a round, yellowish green footstalk. In October, they become of an orange brown, or orange russet, and finally a deep russet. The buds are middle sized, ovate, yellowish brown, half covered by the two external scales. Early in the spring, these scales fall off, and the buds enlarge to a very considerable size. In May or June, they open by the folding back of the large, conspicuous scales, which are numerous, from two to five inches long, and often one or two broad, widening towards the end, and of a rich purple color, invested externally with yellowish silken down. They are tough, of a soft leathery texture, and beautifully fringed.

From the midst of these gorgeous, flower-like scales, appear the leaves, expanding late, but hastening to atone for the delay by luxuriant and rapid growth, and reaching, before the end of June, on the vigorous shoots of young trees, their full length of eighteen or twenty inches.

The male flowers are in slender, pendulous, green tassels, or catkins, three on each common stalk, which comes out at or near the base of the new shoots: the middle one from three to five inches long, the opposite lateral ones half as long, or

more, with a small, slender scale at the base of each. The shining, imbricate scales of the catkins contain each three or four stamens. The inconspicuous fertile flowers are in groups of from two to four together, on the ends of the shoots, containing each two stigmas, surrounded by the four parts of the calyx, which, by their surprising development, form the husk of the future nut.

The fruit of the shellbark is nearly globular, varying much in size, but usually from five to seven inches in circumference. The husk is, in its immature state, green and nearly smooth; but afterwards turns brown, and sometimes almost black. It is of a spongy substance, very thick, and marked with four depressed furrows, by which it separates into as many distinct pieces, one of which is larger than the rest. The nuts, which differ in size and shape, still more than the unhusked fruit, are about an inch long, and from two to two and a half in circumference, white or yellowish white, oblong, and compressed, marked with four distinct angles corresponding to the seams in the husk, prolonged at the extremity, and crowned with the hardened remains of the stigma. They vary very much in hardness and thickness; the best varieties being thinner and softer, and having commonly a rounder and fuller shape, than the poorer sorts. The kernel is very sweet, much superior in quality to that of any other native nut, and, in the best varieties, it is equal to any imported nut. It ripens in October. Every fruit which is much used for food, except this, has been improved by the careful cultivation of many centuries. The shellbark hickory is a proper subject for experiments, to be made with special reference to the improvement of the nut. Those varieties should be selected which unite, in the greatest degree, thinness of shell with fullness and richness of kernel. If as great a change can be wrought as has been effected in the common European walnut, which, in its wild state, is small and thick-shelled, the fruit of the shagbark will be far superior to any nut now known.

The market of Boston, and the other towns of this State, are supplied with these nuts from the vicinity, or the interior of the State; not abundantly enough, however, to prevent a considerable importation from New York and other southern ports.

The wood of the shellbark hickory splits more easily than that of the other species, and has more elasticity. It is therefore preferred for whip-stalks, goads, and ox-bows; and sometimes it is used for making baskets. It has less strength and tenacity than the wood of the pignut hickory, though it possesses in a high degree these characteristic properties.

As fuel, it stands at the head of the list of trees belonging to our climate, or probably to any other. Foreigners who have settled among us regard it as clearly superior to any wood known in Europe. It is the heaviest of our native woods, and yields, pound for pound, or cord for cord, more heat than any other, in any shape in which it may be consumed.

This tree does not often grow to large dimensions. One between the branches of the Nashua river, in Lancaster, and near their confluence, measured eleven feet five inches at the ground, eight feet six inches at three feet, and seven feet six inches at six feet; a fine tree at the Botanic Garden in Cambridge measures more than eight feet at three feet.

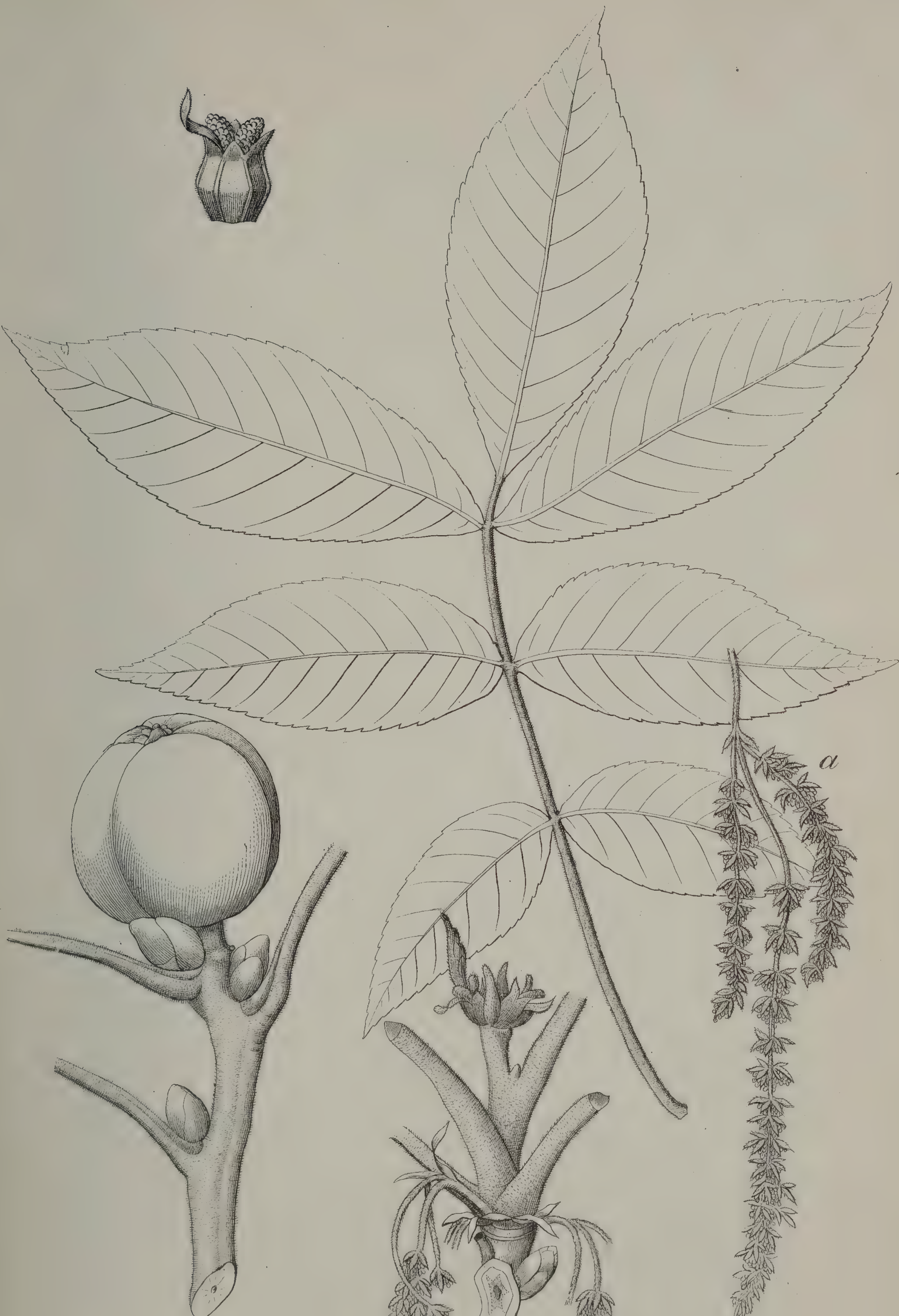
The hickories are infested by a kind of moth, called by Dr. Harris, *Sophocampa barya*, Hickory Tussock Moth (p. 362). A similar moth lives on the black walnut, the butternut, the ash, and the oak. The caterpillar of the beautiful Luna moth also lives on the walnut and hickory. A large and formidable looking caterpillar, that of *Ceratocampa regalis*, devours the leaves of the walnut (p. 399).

Sp. 2. The Mockernut Hickory. *Carya tomentosa.* A. Michaux.

Figured in Michaux, Sylva, I., Plate 35; and in Plate 37 of this volume.

This species is often called the walnut, and is also known by the name of the square-nut hickory. It is also called white heart; though, in old trees, the heart is of the same dark red as in the other hickories. It is liable to be confounded on one side with the shellbark, and on the other with the pignut, hickories. The name mockernut is sometimes heard in this State, and is given to it exclusively in New York. This, like the preceding, is a stately, tall, and finely shaped tree, with an erect trunk, throwing out a few moderately large branches, at a sharp angle, and forming a lofty and graceful pyramidal head. It may be distinguished from the other hickories by the number of its leaflets, which are seven or nine; by the down on its leaves and recent shoots; by the hardness of the husk, and the thickness of the nut; by the roundness of its large covered buds; and by a strong resinous odor in the leaves, buds, and husks. In its general aspect, it resembles the shellbark, as well in the fulness of its foliage as in the size of its leaves. Its branches are more spreading, and its trunk is more like that of the pignut hickory, but less smooth. The color of the bark is dark ashen gray; and on old trees it is rough, with numerous close, narrow furrows, rendering it more rugged than that of any hickory, except the shellbark. A remarkable peculiarity often shows itself in the young trees: while the inner bark is cracked, the cuticle seems to yield, and to cover the whole surface with a smooth, waved covering; the external furrows not beginning to show themselves until the tree has a diameter of six or eight inches.

The recent shoots are of a brown color, very stout, and, early in the season, covered with down. Later, they turn purple, with a dusty appearance. On the older branches, which are



MOCKERNUT HICKORY. (*Carya tomentosa.*)

larger than in the other species, the color changes to gray, which gradually becomes lighter.

The leaves are very large, often eighteen or twenty inches long, on very large downy footstalks. The leaflets are seven or nine, nearly sessile, except the terminal one, which has a short stem; they are rather large, egg-shaped, elliptical, or pear-shaped, smooth above and downy beneath, with large, sharp serratures, and terminating in a short point. They are remarkable, particularly in the early part of the season, for a strong resinous odor. They have more substance than those of the other species, and shrivel less under the touch of the frost. In autumn they assume a full deep orange brown, gradually fading to russet.

The buds are large, round, short, and covered with downy, yellowish brown scales.

The male flowers are on triple catkins from three to six inches long, the middle one longest. They consist of three-lobed, pointed scales, imbricately arranged, and differ from those of the other species in being somewhat more hairy. The fertile flowers are very small, and consist of a calyx with four segments, from which issue two hairy, irregular, ragged stigmas.

The fruit of the mockernut varies remarkably in size, shape, and appearance, but is commonly from four to six inches in circumference. It is sometimes nearly orbicular and smooth, with slightly depressed furrows, but more frequently pear-shaped, with prominent seams and a granulated surface. The husk separates nearly to the base into four unequal lobes, sometimes as thick as those of the shellbark, and sometimes quite thin, but always becoming very hard. It has, in a remarkable degree, the strong resinous scent characteristic of the species. The nuts are whitish, commonly somewhat pear-shaped, and less compressed and with less prominent angles than those of the shellbark. But a variety is found with prominent angles, and is distinguished by the name of the

square nut. The shell is very thick and hard, and difficult to crack. The kernel is sweet, and, in some varieties, as large as in the shellbark, but the difficulty of extracting it makes it far less valuable. The fruit ripens in October.

The wood is characterized by the hardness, tenacity, and weight which belong to all the trees of this genus. It is less easily cleft than that of the shellbark, but next to it in value as fuel; and less tenacious than that of the pignut, and therefore less valued for its uses in the arts. But the differences in these respects are so slight, that only the most careful observers have noticed them. When young, it is supposed to be whiter than that of the other hickories, and thence the tree receives the common name of white-heart hickory. The Indians made of the bark of one of the hickories, probably this, with the assistance of a vegetable acid, — the only kind of acid they had, — a black dye, said to have been deep and permanent.

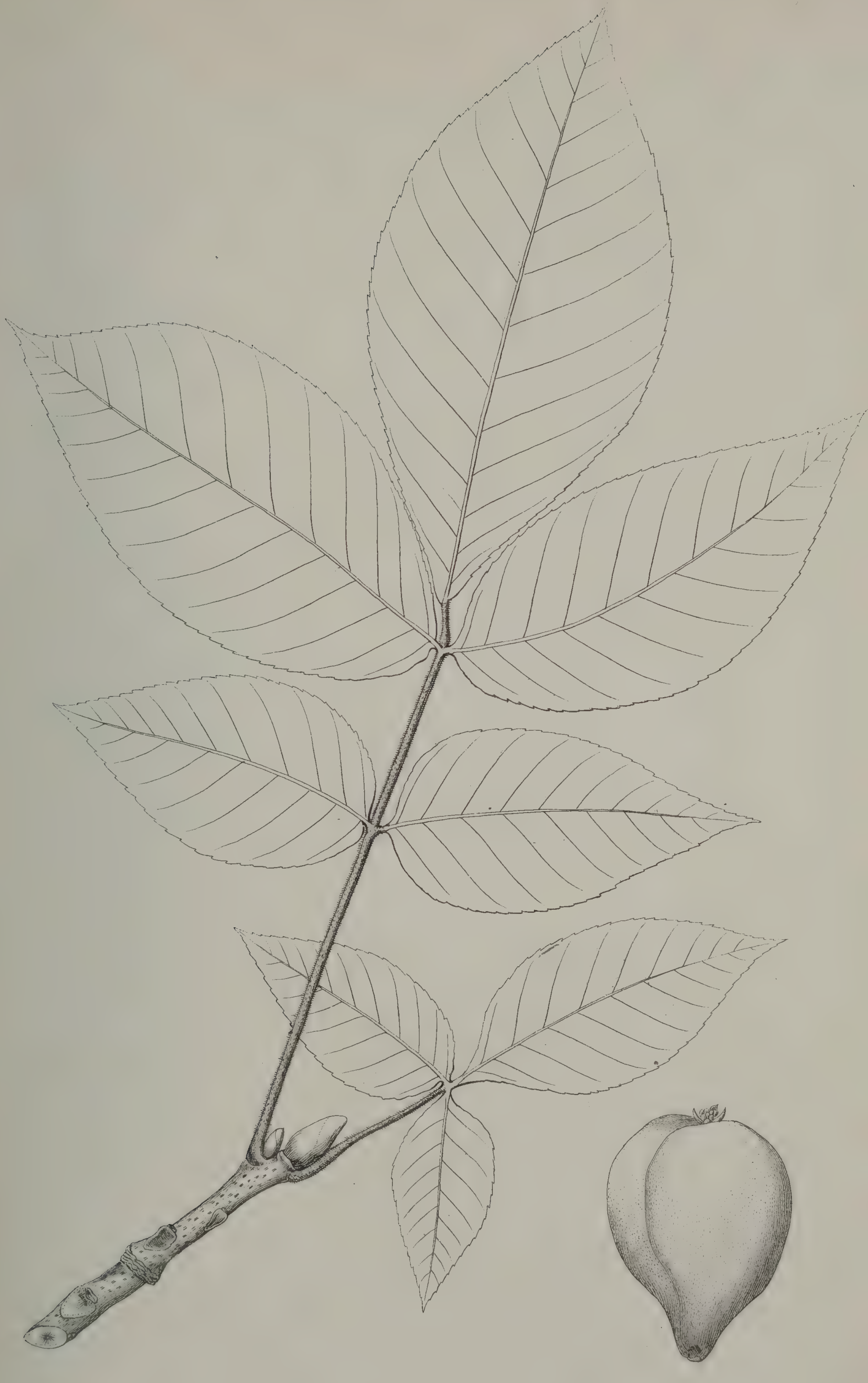
Michaux, who had made experiments upon the several species, pronounces the mockernut to be the slowest in its growth of all; and he thinks it is the most liable to the attacks of worms, and therefore one of the least valuable for cultivation. He says it grows on poorer soils than the other species, but attains a considerable size only when growing on a rich soil. In this State it flourishes in company with the shellbark; and prevails in the eastern parts, particularly in the vicinity of Boston, and more on the southern side than on the northern or eastern.

Sp. 3. The Pignut Hickory. *Carya porcina.* F. A. Michaux.

Figured in Michaux, Sylva, Plate 38; and in our Plate in this volume.

Although the pignut hickory occurs more frequently than any other species, yet the name is often made to include the mockernut and the bitternut.

The bark of the pignut hickory is broken into finer and more



PIG NUT HICKORY. (*Carya porcina*)

numerous rugosities than either of the preceding species, and begins to assume its roughness at an earlier age, and on smaller trunks and branches. Its color is a rather light bluish, ashen gray, and it is often clouded with large patches of gray and sulphur-colored or bluish lichens. On old trunks the bark is comparatively smooth, but sometimes broken into larger and less regular plates than the mockernut, and the plates are rough and often projecting, somewhat as on the shellbark.

The recent shoots are smaller than those of the two preceding species, tapering, smooth, often polished, purple, with numerous long dots, and gradually turning brownish gray; the larger branches are of a uniform bluish gray. The leaves are long, with three, five, or seven leaflets, on a long, smooth footstalk. The leaflets are nearly sessile, narrower than in the former species, smooth on both surfaces, tapering gradually at both extremities, and ending in a long point. The terminal leaflet is inversely egg-shaped, on a short stalk. When crushed, the leaves, as well as the husk of the nuts, give a not unpleasant odor, entirely different from the characteristic odor of the mockernut hickory. In autumn, as early as October, the leaves change their color, becoming of a russet orange, or often a rich orange with a brown tint overspread.

The buds are egg-shaped and pointed, or rounded, smaller than in the last species, the outer scales of a polished brown.

The fruit of the pignut hickory varies still more in shape than that of the other hickories, and hardly less in size. It is sessile on a short terminal stalk, and most commonly pear-shaped; at least, that is the shape which I have found most common in Massachusetts, and that almost universally connected with a leaf of five leaflets. This has been called the *fig-shaped* (*ficiformis*), from its resemblance to a fresh fig. Another variety, also common, has the fruit nearly round, but often irregularly shaped; and a third, less common, has a large broad fruit. These differences in the shape of the fruit are connected with corresponding differences in the leaves, bark,

and appearance of the tree, inducing several botanists to consider them as distinct species. Michaux is probably right in making them only varieties. The husk has a smooth or granular surface, with seams depressed above and often prominent below, and sometimes so from top to bottom, extending nearly to the base, and dividing it into four unequal lobes. It is very thin, though not equally so in all the varieties, and crustaceous, but not hard. The nut has a hard and tough shell, sometimes thin, but oftener pretty thick, of a bluish gray color and smooth surface. The kernel has at first a hazel-nut taste, which turns presently to a disagreeable bitter. Some varieties have a nut almost equal to an inferior shellbark. The nuts grow single, or two, three, or four together. They are often very abundant, several bushels being produced on a single tree, and they are then usually found growing in pairs.

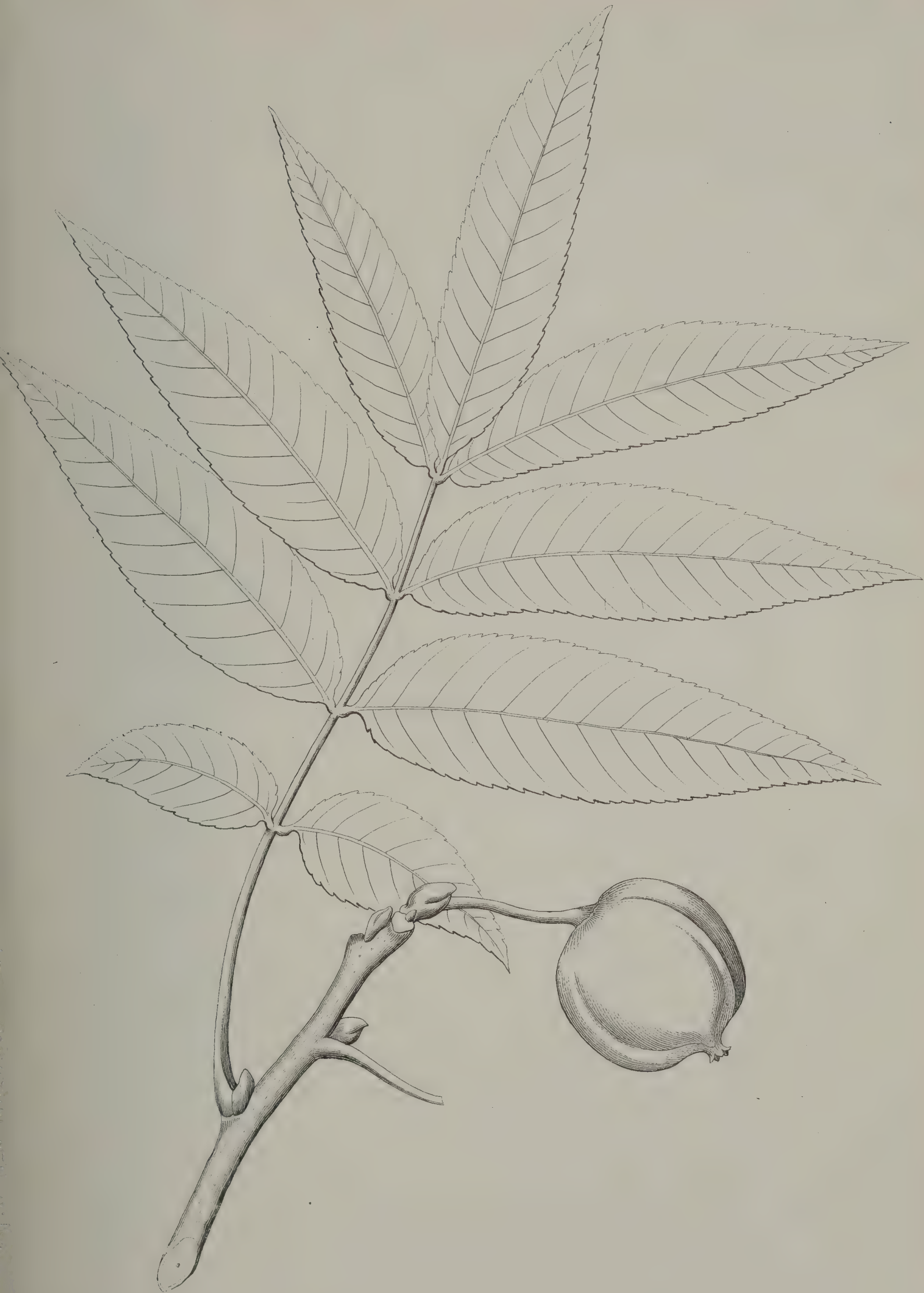
The wood of the pignut hickory, varying greatly in the different varieties, has, in some, the excellent properties of this class of trees in greater perfection than either of the other species. It is therefore preferred for the axle-trees of carts, the heads of mallets and beetles, and the handles of axes. A beetle made of it, and used to drive stakes and iron wedges, outlasts, I am told, any that can be made of any other wood, foreign or native. As fuel, it is next to the species already described, and superior to all other woods.

This hickory grows to a great size, being sometimes three or four feet in diameter, and rises to the height of seventy or eighty feet, with a trunk very gradually tapering, and pretty large limbs.

Sp. 4. The Bitternut Hickory. *Carya amara.* F. A. Michaux.

Figured in Michaux, Sylva, I., Plate 33; and on Plate 39 of this volume.

This species, though perfectly distinct and well defined, is very generally confounded with the last described, or, if at all distinguished, is called the bitter pignut.



BITTERNUT HICKORY. (*Carya amara.*)

It may be easily recognised by the smallness and slenderness of its leaves, which give it much the aspect of an ash; by its small, pointed, yellow buds; by the winged projections at the upper part of the fruit-seams of the husk; and by the bitterness of the kernel of the thin-shelled nut.

The bitternut hickory is found abundantly in the vicinity of Boston, particularly in Chelsea and Brookline. In Cambridge and the towns beyond, it more rarely occurs, its place being taken by the pignut, as it is in Dorchester and towards Milton hills. On the hills in Brighton the four species are more equally mingled than I have found them elsewhere. It also occurs in Worcester County, and in the counties along the Connecticut.

The bitternut hickory is the most graceful of these beautiful trees, and remarkable for its finely cut foliage. It raises a noble columnar top, to the height of sixty or seventy feet, enlarging upwards, and broadest at forty or fifty. The trunk gradually tapers from the ground; less rough than most large trees, with a few loose portions of its light granite-gray bark here and there projecting, and differing from the color of the other hickories by a faint yellow tinge. The recent shoots are of an orange-green, smooth, and dotted with orange dots. As they grow older, they change to a brownish gray. The buds are small and very characteristic; they are of an orange-yellow color; the terminal ones long, curved, flattened, and pointed, the axillary ones shorter and rounded. By observing these, the tree may be easily distinguished at any season of the year.

The leaves are on small stalks, which are somewhat downy, and often flattened and winged. The leaflets are from seven to eleven, small, narrow, lanceolate, sessile, inequilateral, smooth on both surfaces, or with a slight scattered down beneath.

They are of a lively green, and, in autumn, assume often a rich orange color, a faint tinge of which they retain when the other species have grown russet and brown. Such is the prevailing character of the leaves in this vicinity. Elsewhere they are sometimes very large.

The male flowers are in ternate, pendulous catkins, from three to six inches in length, very slender, and somewhat downy, and bristling less with the prolonged points of the scales than in the other hickories. The inconspicuous fertile flowers are on the ends of the branchlets, single, or two or more together; remarkable, when closely examined, for the very broad stigmas which overlie the segments of the scaly and resinous calyx, the future envelope of the fruit.

The fruit of the bitternut hickory is nearly round, or slightly compressed on one side, and is distinguished by the prominent winged edges of the seams, only two of which extend more than half way down. The husk is smoöthish, or slightly granulated, thin and fleshy, and never becomes very hard. The nut is white and smooth, broader than it is long, and somewhat heart-shaped at the top. The shell is so thin that it may be broken by the fingers, and contains a kernel remarkably corrugated, and so bitter that squirrels refuse to feed on it while any other nut can be found, and even boys will not eat it. From the bark or husks of some one of the hickories, probably this, the Indians are said to have procured materials for coloring a permanent yellow.

These are all the hickories of whose occurrence in Massachusetts I am confident. The varieties of the pignut may hereafter be elevated into species; and the species called by Michaux the nutmeg hickory will probably be found here. I have seen nuts and leaves which reminded me of the description and figure of this species, but, forgetting their locality, I have been unable to verify my conjectures by observation.

EUROPEAN BIRCH. *Betula alba.*

FAMILY V. THE BIRCH FAMILY. *BETULACEÆ.* Richard.

The birch family consists of graceful trees and shrubs, natives of the colder regions of each hemisphere, with alternate, entire, dentate or serrate, deciduous leaves. The sterile and the fertile flowers are arranged in distinct aments on the same plant. The male flowers are in cylindrical, pendent tassels or aments, made up of three-flowered scales, on the sides or ends of the branchlets; the female, in shorter, thicker aments, usually erect, of two or three-flowered scales, with long, diverging, colored stigmas. Both are made up of imbricate scales. The fruit, called a strobile, is the enlarged female ament, usually more or less egg-shaped, sometimes cylindrical, The aments are formed in the summer, or early autumn, and remain unprotected through the winter.

The bark is thin, and generally arranged in thin flakes, and has astringent properties. The root is rather large, with long, tapering branches, and numerous radicles. The wood is soft, close, and fine-grained, rather light, and not durable when exposed to alternations of dryness and moisture. Several of the birches are valuable as timber trees, most of them as fuel, and all as ornaments in the landscape. The wood, especially of the root, is remarkably beautiful. They abound in the northern parts of America, and are sometimes found in the mountains of Mexico, and countries farther south. In Europe they are found in all regions, from Etna to Iceland.

The great defect of birch timber is its proneness to decay. This may be in a degree prevented by felling the tree in summer, or in early autumn, and immediately stripping off the bark. So long as the bark remains, the sap and other moisture favorable to decay is kept in, and the seasoning prevented.

The birches have a great abundance of sap, which is sometimes obtained in large quantities by tapping the vigorous

trees. It is sweetish, with an agreeable acid taste, and forms a pleasant drink. It is said to be sometimes used, with perry, in the manufacture of what seems to be, while new, tolerably good Champagne wine. It is also used to make vinegar. The inner bark of some species is used to give a bright orange dye.

Trees of the birch family are nowhere of more importance, variety, and beauty than in this country. There are but two genera:[1] 1. The Birch, known by its thin and delicate leaves, and bark made up of strong, horizontal fibres; and, 2. The Alder, known by its thick leaves, polished, dark-colored bark, and woody, cone-like, persistent strobiles.

V. 1. THE BIRCH. *BETULA.* Tournefort.

This genus has its sterile aments, made up of imbricate scales, arranged in threes, with twelve stamens placed beneath the middle scale, and its fertile aments of three-lobed scales. The ovary is much compressed, crowned with two styles, and divided into two cells, the ovule in only one of which comes to maturity. The seed-vessel is a samara, with thin, winged, membranous borders, like that of the elm. The buds are sessile, covered with imbricate scales, and contain the leaves folded together, and overlying each other. The leaves are alternate on the growing branches, and in pairs elsewhere; on the canoe, the gray, and some other birches, they are sprinkled with glutinous dots when young. The sterile aments make their appearance in July, remain unprotected on the branches through the autumn and winter, and expand,

[1] The Clethropsis, a plant of the interior of Asia, discovered by V. Jacquemont, and described from his specimens, by Cambessedes, must take its place, apparently, between the birch and the alder, and nearer to the latter. See *Voyage dans l'Inde, par Victor Jacquemont*, Tome IV., p. 158, Plate 159.

I learn, from the eleventh volume of Spach, "Histoire des Végétaux," that he has placed Clethropsis in this family. He has also made two other genera, from species of *Betula* and *Alnus*.

before the leaves, with the earliest warmth of spring. The scales of the fertile aments detach themselves easily, and fall from their stems, which are always undivided. This genus contains not far from twenty species,[1] of which nine or ten are found within the limits of the United States or its territories. The rest belong to the north of Europe, except one found in Japan, one in Terra del Fuego, and some which grow among the mountains of Central Asia.

No trees are more distinguished for their light and feathery foliage, and the graceful sweep of their limbs, than the birches. The European birch, Coleridge calls the most beautiful of forest trees, — the lady of the woods. Our birches are still more graceful. It is one of the most common trees in every part of Europe, often taking the shape called the weeping birch, and everywhere adding grace to the beauty of the woods. From the delicate and slender gray birch, throwing its thin leaves and often pensile spray lightly on the air, to the broad-headed black birch, with its rich, glossy, and abundant foliage, weighing its pendulous branches almost to the ground, — no family affords such a variety of aspect. There are five birches in Massachusetts which are trees, besides one which is a shrub. They are thus distinguished: —

1. The Black Birch, by having its bark dark colored;
2. The Yellow Birch, — bark yellowish, with a silvery lustre;
3. The Red Birch, — bark reddish or chocolate-colored, very much broken and ragged;
4. The Canoe Birch, — bark white, with a pearly lustre;
5. The Gray, or White Birch, — bark white, chalky, dotted with black;

[1] Regel, in De Candolle's "Prodromus," Vol. XVI., makes twenty-nine species; and yet considers the white, the canoe, and the yellow as sub-species of the European. Between the white and the European there is great similarity; but to make the others mere varieties is entirely to disregard the general appearance, and the colors and qualities of bark, leaves, and wood.

6. The Dwarf, or Shrub Birch, — bark covered with glandular points, a shrub.

Michaux arranged the birches in two sections: one comprehending trees whose fertile aments are sessile and erect, — the Black, the Yellow, the Red, and the Glandular birches; the other, those whose fertile aments are stalked and pendulous, — the Canoe, the White, and the common European. The division seems a very natural one, bringing together those which are most nearly allied in habit and in the qualities of their wood.

Sp. 1. The Black Birch. Sweet Birch. *B. lenta.* Linn.

Figured in Michaux, Sylva, II., Plate 74; and in our Plate.

The black birch is easily distinguished by the dark color of its bark; and from this obtains the name by which it is almost universally known. From its resemblance, in bark and leaves, to a cherry tree, it is also sometimes called the cherry birch; and, from the agreeable spicy odor and taste of the leaves and inner bark, it often has the name of the sweet birch, or fragrant birch, as in Bryant's lines on the murdered Traveller, —

> " The fragrant birch above him hung her tassels in the sky,
> And many a vernal blossom sprung and nodded careless by."

The black birch is the most beautiful, and, for the useful properties of its wood, the most valuable of its family.

Early in spring it expands its long aments, which hang like tassels of purple and gold, and continue for many days shedding beauty and fragrance, at a time when few other objects feel the kindly influences of the season; and it is amongst the first trees to put forth its leaves. In the forest, in the rich, cool, moist soils which it prefers, on mountain sides, or the banks of streams, it often attains the height of sixty or seventy feet. On an open plain, growing by itself, it is a round-

Sprague del.　　　　Armstrong & Co. lith. 156 Congress St. Boston

BLACK BIRCH. (Betula lenta.)

headed tree, and from the length and slenderness of its somewhat tortuous branches, they become pendulous, forming the most graceful of the weeping trees. It is found in every county, but flourishes most in the mountainous districts. The light, winged seed often lodges and vegetates in crannies of almost inaccessible rocks, and thence pushes down its roots, over the bare rock, to a considerable distance, in search of a foothold in the soil. It is often, too, seen growing from the top of the mass of soil and stones adhering to the roots of an old, overturned tree.

The trunk in small trees is covered with a smooth, dark purple bark, entire, or, in larger trees, with distant chinks. On very old trunks, it is broken into horizontal, straight-edged plates, which become loose at the end, and scale off in broad sheets. The spray is very slender, of a reddish bronze color, gradually deepening to a very dark polished bronze, almost black, dotted with conspicuous gray dots. The buds are conical, and pointed. The leaves are two or three inches long, and one or one and a half wide, oblong-ovate, heart-shaped at base, tapering to a point, finely and sharply but irregularly serrate, smooth and somewhat impressed on the veins above, paler, and with the veins straight and prominent, and hairy beneath, the under surface dotted with numerous resinous but not viscid dots. They are on short, curved foot-stalks, sometimes a little hairy. On the lower parts of the branches, they are in twos; towards the ends, alternate. In autumn, they assume various shades of ochreous yellow, or pale orange, or an extremely delicate yellow, lighter than orange, nearly a lemon color.

The male flowers are on cylindrical, pendulous catkins, from two to four inches long, and one quarter of an inch wide, set with loosely arranged scales. Each flower is within a broad-ovate, shield-like, pointed, brown scale, to which are attached two smaller ones below, and within, three thinner, bearded scales, supporting twelve stamens with single-lobed anthers,

growing by twos on pedicels, with often a slender scale at the base of each. These catkins are towards the end of the branches, occupying each the place of a pair of leaves.

The female flowers are on smaller catkins, about half an inch long, and one eighth in diameter, lower on the branches, with two leaves at the base of each. The scales are close set, imbricate, small, green, rounded or pointed at the end, with an ear-like lobe on each side at the base. Within each are three pairs of ovaries, with awl-shaped stigmas.

The fruit is erect, nearly sessile, elliptical, or cylindrical, with rounded ends, an inch or somewhat less long, and half an inch thick, made up of shining, resinous scales of three equal lobes, closely imbricated; and having three seeds, ovate and with broad wings, within each.

Michaux found this tree in Nova Scotia, in Maine, and "on the estate of Vermont," as Loudon has translated him; also in the Middle States, and on the Alleghanies, throughout their whole extent, till they terminate in Georgia.

The wood is easily wrought; and, as it has strength, firmness, and durability, it is much used in the arts. It has a delicate rose color, which deepens from exposure, but never becomes dark; and the difference between the annual circles of different degrees of maturity giving a rich, clouded, or, as it is technically called, landscape appearance. It is in request for the panels in the foot and headboards of bedsteads, and in other cabinet furniture. It is sometimes used to make yokes, which proves its strength to be considerable. It is also used for joists, for bedsteads, and for chairs, for which it is a beautiful material, though it does not bend so well as yellow birch. Small tubs are made of it, and it is sometimes used for backboards in carriages.

The black birch is excellent for fuel, — next, indeed, to the rock maple, in the Green Mountains, and in the northern part of New England, where it comes to the greatest perfection. A decoction of the bark, with copperas, is used for coloring

YELLOW BIRCH (*Betula lutea*)

woollen a beautiful and permanent drab, bordering on wine color.[1]

In a pasture south of Meeting-house Pond, in Westminster, among the broad clumps or islands of broad-leaved laurel, I found a black birch in July, 1839, which, at three feet from the ground, measured nine feet and five inches in girth. This tree was remarkable for the projection of the roots just above the surface; for the deep rifts in the old bark, which peeled off in broad plates; and for an enormous fungus which had attached itself to the bottom of one of the cracks. This measured eighteen inches across, eleven in height, and projected eleven inches horizontally from the trunk.

Sp. 2. The Yellow Birch. *B. excelsa.* Aiton.

Figured in Michaux, Sylva, II., Plate 73; Du Hamel, 3, 52.

In its native forests, the yellow birch is a lofty tree, lifting its head into the sunshine among the tall hemlocks, rock maples, and ashes, with which it grows. It is distinguished by its yellowish bark, of a soft, silken texture, and silvery or pearly lustre. The recent and still growing shoots are slender, of a reddish, purplish, or deep bottle green, somewhat hairy, and dotted with gray. The older branchlets are of a polished copper, or golden bronze, or of a dark alder green, with often a thin, grayish, transparent film scaling off horizontally in rolls. On the larger branches in young trunks, the bark begins to assume a metallic lustre, with the horizontal dots long and conspicuous, and the epidermis loose, in narrow strips, hanging out like the frayed ends of narrow ribbons. The trunk then begins to take a yellowish color, and thin lichens intersperse their black-dotted, white clouds. On vigorous trunks of a foot in diameter, are seen long rolls of loose bark, adhering

[1] This birch, as well as the yellow, yields a very large quantity of sap; more, probably, than any other kind of tree.

by the middle or by one end; while, in very old trees, the trunk becomes rough with large, broad, gray scales, separated by furrows, and giving lodgment for the mosses and liverworts and larger lichens which abound in the deep shades of the primeval woods. The yellow birch is often found seven or eight feet in circumference, measured above the bulging of the roots, and with only two or three large branches, near the top, at sixty or seventy feet from the ground. The roots often swell out above the surface in a picturesque or sometimes fantastic manner.

The leaves, except on the growing shoots, are in twos, on short, curved, hairy footstalks. When they first come out they are covered with hair. They are oval or elliptic, or more or less egg-shaped, contracted towards the base, and heart-shaped, tapering to a rather long point, more coarsely serrate than those of the black birch, the serratures prolonged, smooth, or a little hairy above when mature, pale and hairy along the mid-rib beneath. On the green, hairy, growing shoots the leaves are alternate; with short, taper, lance-shaped stipules, which soon fall off. In autumn the leaves become of a soft, pale yellow.

The catkins of the male flowers are two or three inches long, at the ends of the branches, somewhat larger and shorter than on the black birch; but, like them, hanging like golden and purple tassels on the branches, just as the leaves are beginning to unfold. The scales are slightly fringed. The aments of the fertile flowers are short and nearly erect, in the common axil of two leaves, on the sides or ends of the branchlets. When fully grown and mature, they form an egg-shaped cone, about an inch or an inch and a quarter long, and four or five eighths of an inch thick, nearly sessile, erect, and formed of stiff, tough, three-lobed scales, hairy without, and containing, within, three inversely kidney-shaped winged seeds, with the two brown styles in a notch at the top.

The yellow birch has not often been cultivated for ornament,

but it has great beauty. In travelling, we sometimes see it on the edge of a wood, with its abundant soft, green, often drooping, foliage, between masses of which is seen the gleam of the light bronze trunk with its silver and pearly lustre, showing what might be its effect introduced in ornamental woods.

The wood of this tree is applied to numerous uses. Bending readily, it is particularly adapted to the making of the posts and bars of chairs. It is used for the staves of small and inferior casks, for boot-trees, and for joists and bedsteads. In Richmond, among the Shakers, floors are made of it, as also of the black birch. It is valuable as fuel.

At Lanesboro', I measured, in 1838, a yellow birch of ten feet seven inches girth at the ground.

Sp. 3. The Red Birch. *B. nigra.* Aiton.

Figured in Michaux, Sylva, II., Plate 72; Loudon, 234.

This tree is somewhat different in aspect and character from the other birches. It is usually found bending over a stream, with its roots always in the water; or growing, in company with the swamp white oak and red maple, in places which during one half the year are inundated. In such situations it is rarely erect, but commonly leans towards the water. When erect and standing alone, it is a singularly graceful tree, with its upper limbs long and sweeping out, like those of an elm, and its trunk almost clothed with small, leafy, pendulous branches. Usually, it is remarkable for throwing out many small branches near the ground, and for the denseness and multitude of its branches above. The stem, in trees thirty feet high, is covered with a reddish-white bark, more loose and torn than that of any other tree. The external bark, wanting the great tenacity of the white and canoe birches, separates in flakes an inch or two broad, adhering by one end, while the other projects like an ample fringe. The color of this loose bark, when seen by transmitted light, as we see it from the

ground, is a light red; when seen by a reflected light, it has a reddish brown or chocolate color. The trunk on old trees is dark gray, very rough, with little resemblance to that of any other birch, except the black, and very much like the black cherry, but not so dark.

The recent shoots are brown and downy; those of a year or more are black, dotted with light gray. The branches are very numerous, small, dependent, with bark on the larger ones brownish or whitish red and excessively ragged. Leaves heater-shaped, or rhombic, the larger ones three or three and a half inches long, and two or two and a half wide, uniformly acute at the base and at the extremity, conspicuously doubly serrate, bright green above, glaucous beneath. The leaf-stalks are short, and, with the leaf, downy when recently expanded. The bark within is of an ochrey orange red; the wood, white and hard.

This tree is found growing abundantly on the Merrimac River, and on Spicket River and the other tributaries, and in the neighboring swamps. It is there called the river birch. As fuel, it is said to be nearly equal to hickory, and the tree is of very rapid growth. The wood is close-grained and very hard, and, when kept dry, very durable. It has not been much used in the arts. Yokes have been made of it, which are excellent, except that they are apt to crack from exposure to the sun, which defect may be obviated by water-seasoning.

The trees are usually about a foot in diameter and fifty feet high. One measured five feet two inches in circumference, and appeared to be sixty feet high.

The younger Michaux assumes the banks of a small river in New Jersey, ten miles from New York, as the northern limit of this birch. He found it abundant in Virginia and North Carolina, but rarely more than two or three feet in diameter and seventy feet high. It is on many streams in Pennsylvania and Ohio. It would doubtless flourish as well in Massachusetts as in either of those States, as its growth is very luxuri-

CANOE BIRCH. (*Betula papyracea.*)

ant in the limited region to which it seems to be here confined. The seed-bearing cones are said to be ripe in June.

Michaux says that the wood is pretty compact and nearly white, and presents the peculiarity, like that of the June berry, of being longitudinally marked with red vessels, intersecting each other in different directions. The negroes make bowls and trays of the wood, and, of the young stocks and of branches not exceeding an inch in diameter, hoops, particularly for rice casks; and, like all the other birches, it promises to be very hardy. It would doubtless furnish beautiful material for furniture. In Philadelphia its twigs are made into brooms for streets and court-yards. A similar use is made of the twigs of the gray birch in some parts of New England.

The red birch might be easily propagated along the streams of every part of New England; and would serve the same purpose as the alders, in preventing the washing away of the banks, while it would form a still more beautiful fringe, and furnish a useful growth for fuel and for the arts.

Sp. 4. The Canoe Birch. *B. papyracea.* Aiton.

The leaves and strobile are figured in Michaux, Sylva, II., Plate 69; and in our Plate; the tree, leaves, and aments in Loudon, Arboretum, VII., Plate 236.

The paper birch is a northern tree, being found as far north as latitude 65°. It grows naturally on river banks and in moist, deep soil, flourishing in almost any situation, but never attaining a very large size in Massachusetts. It is a picturesque tree; the points of light from its white trunk producing a brilliant effect in the midst of its soft but glittering foliage, hanging, as we often see it, over some mountain stream, or sweeping up with a graceful curve from the side of its steep bank.[1]

The recent shoots are of a reddish or purplish olive green,

[1] I have cultivated this beautiful tree for more than twenty years, and find it growing more luxuriantly than any other tree, except the European Birch.

gradually deepening, in successive years, into a dark copper bronze, conspicuously dotted with grayish brown dots, and contrasting strikingly with the white trunk. The larger branches and upper part of the trunk, and portions of the lower, have often a red tinge, whence the tree has been sometimes mistaken for the red birch, which is not found quite so far north. The smooth white bark of the trunk may be easily separated into thin horizontal layers, of an orange color within. The lenticellar dots of the twigs become, on the larger trunks, horizontal stripes of a yellowish brick or orange color, two or three inches long, and a line wide.

The leaves are alternate on the growing branches, and in pairs below, on tapering footstalks, of one quarter or one third of their length. They are from two to four inches long, and sometimes more than two wide, often inequilateral, broad, oblong-egg-shaped, inclining to heater-shaped, tapering to a point, irregularly, doubly, and coarsely, but sharply, serrate; smooth above, roughly reticulated beneath; dotted above and beneath, when young, with resinous, silvery dots, and downy about the axils of the veins beneath. They resemble the leaves of the common gray birch, but are broader towards the extremity.

The male flowers are in pendulous catkins, three or four inches long, with the scales very slightly fringed. The fertile catkins are longer than in the other birches, and have their scales three-lobed at base, and also slightly ciliate. The stigmas are longer than in the white birch, and give the slender aments a rougher appearance. When mature, the fertile catkins are cylindrical, an inch and a quarter or half long, pendulous on slender stalks half an inch in length. They are made up of imbricated, three-lobed scales, the middle lobe acute, the side lobes orbicular, enclosing three ovate seeds with broad, thin, membranaceous wings and persistent styles, resembling a winged insect with antennæ. The fruit, like that of the other birches, is full grown in July, at which time the

male catkins of the next year begin to show themselves at the ends of the branches.

From the tough, incorruptible bark of the canoe birch, were formed the canoes of the former inhabitants of New England, models of ingenuity and taste, so admirably adapted, by their lightness and shape, to the interrupted navigation of the savage. Michaux has given an interesting account of the various uses of the bark: —

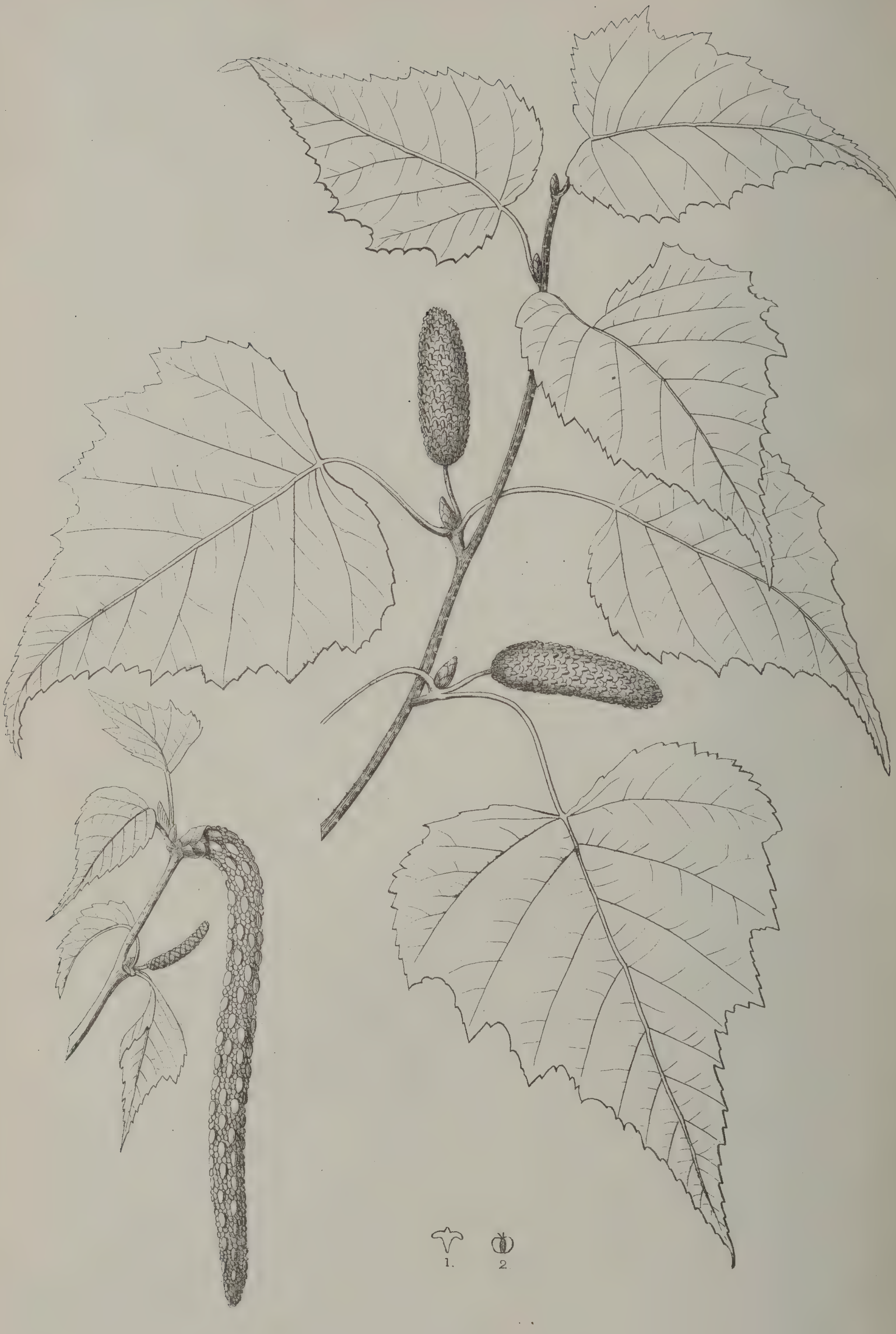
"In Canada, and in the District of Maine, the country people place large pieces of it immediately below the shingles of the roof, to form a more impenetrable covering for their houses; baskets, boxes, and portfolios are made of it, which are sometimes embroidered with silk of different colors; divided into very thin sheets, it forms a substitute for paper; and, placed between the soles of the shoes and in the crown of the hat, it is a defence against humidity. But the most important purpose to which it is applied, and one in which it is replaced by the bark of no other tree, is the construction of canoes. To procure proper pieces, the largest and smoothest trunks are selected: in the spring, two circular incisions are made, several feet apart, and two longitudinal ones on opposite sides of the tree; after which, by introducing a wooden wedge, the bark is easily detached. These plates are usually ten or twelve feet long, and two feet nine inches broad. To form the canoe, they are stitched together with fibrous roots of the white spruce, about the size of a quill, which are deprived of the bark, split, and suppled in water. The seams are coated with resin of the Balm of Gilead. Great use is made of these canoes by the savages and by the French Canadians, in their long journeys into the interior of the country: they are very light, and are easily transported on the shoulders from one lake or river to another, which is called the *portage*. A canoe calculated for four persons with their baggage, weighs from forty to fifty pounds; some of them are made to carry fifteen passengers." — *Michaux*, *Sylva*, II., p. 87.

"In the settlements of the Hudson's Bay Company, tents are made of the bark of this tree, which, for that purpose, is cut into pieces twelve feet long and four feet wide. These are sewed together by threads made of the white spruce roots, already mentioned; and so rapidly is a tent put up, that a circular one of twenty feet in diameter, and ten feet high, does not occupy more than half an hour in pitching. The utility of these 'rind tents,' as they are called, is acknowledged by every traveller and hunter in the Canadas. They are used throughout the whole year: but, during the hot months of June, July, and August, they are found particularly comfortable." — *Loudon*, *Arb.* III., p. 1709.

This birch, in some parts of the northern regions, attains a diameter of six or seven feet. It is said not to occur far south of the Hudson.

The heart-wood of the canoe birch has a reddish hue. The sap-wood is beautifully white. It is soft, smooth, takes a fine polish, with a pearly lustre, and is therefore fitted for ornamental works. But it is perishable, when exposed to alternations of moisture, and not remarkable for strength. A canoe birch cut in summer and kept constantly from the weather, is very durable, and becomes very hard. I have seen studs made of it nearly forty years old, entirely free from decay. It is used in the manufacture of chairs, and in other cabinet work. A portion taken from a part of the trunk from which a large branch issues, makes a beautifully feathered and variegated surface for the front of a bureau, or for a table. It is also used for hat-blocks, and for many uses of the turner. The wood of its root is extremely beautiful.

Formerly, when large old trees of this species were more common, the bark was used in the manner described above by Michaux, being placed beneath the shingles. Many old buildings in the back parts of New England are still found covered in this way. Carefully laid, it makes a covering impenetrable to rain, and a most effectual screen against heat and cold; and it is almost imperishable.



WHITE BIRCH. *(betula populifolia.)*

Sp. 5. The White Birch. The Gray Birch. *B. populifolia.* Aiton.

Leaves and strobile figured by Michaux, Sylva, II., Plate 71; and in our Plate; the tree, leaves, and aments, by Loudon, Arboretum, VII., Plate 235.

The white birch, or the little gray birch, as it is often more descriptively called, can be mistaken for no other tree except the canoe birch, from which it is distinguished by the grayish color and chalky surface of its harder bark, and by the marked triangular form of its leaf, which tapers to a very long, slender point. It is a tree of third-rate, never, so far as I have seen, even in the most favorable situations, attaining the height of forty feet, and usually not over twenty-five or thirty. One of the largest I have ever seen, measured four feet and two inches in girth at the ground, and two feet eight inches at three feet above. It is, in many parts of New England, beyond whose limits it is not known to extend far, southward or northward, the most common companion of the pitch pine, in the poorest sandy soils. But, independently of its associations with sterility, which it is well entitled to, as it springs up and grows rapidly in spots deserted by every other deciduous tree, it is a graceful and beautiful object; enjoying, in an eminent degree, the lightness and airiness of the birch family, and spreading out its glistening leaves on the ends of a very slender and often pensile spray, with an indescribable softness. It nearly resembles, when both are young, the European birch, which Coleridge calls

> ——— "most beautiful
> Of forest trees — the lady of the woods."

It often makes a striking appearance at a little distance, from its delicate and elegantly cut, feathery foliage, and the strong contrast between the white trunk and the black branches, and the bright speckles of the sun's light thrown back from the glossy leaves.

The stem is erect, or, more usually, ascending, clothed with a chalky white or grayish white bark, with a triangular dusky space below the branches. The branches are numerous and small, of a very dark purple, looking black at a distance, in contrast with the white trunk, and conspicuously spotted with oval, horizontal, gray dots. The recent shoots are brown, closely dotted with round dots, and, in the next year, often scattered with white scales. The leaves are on long slender footstalks, triangular or heater-shaped, rounded or right-angled, or heart-shaped at base, ending in a long tapering point, irregularly toothed, the larger teeth having an abrupt sharp point, shining on both surfaces, and glutinous when young. In autumn, they fade to a rich yellow.

The male flowers are on cylindrical, brownish-yellow, pendulous catkins, usually single at the end of the branches, three inches long. The larger scale is shield-like, the next two rounded, the inner three inversely egg-shaped, all fringed; the former three brown, the latter yellowish. The fertile flowers are in smaller and more slender, erect, lateral catkins, with green scales. The stigmas are shorter than in the other species, and the catkins thence look smoother. When mature, the ament becomes a cylindrical strobile, an inch or more long, and two or three eighths thick, on a footstalk three eighths of an inch long.

The white birch is valuable for the rapidity with which it grows on any kind of soil, or even without soil. It makes a pleasant border for the road, — infinitely better than none. I have found myself sensibly relieved, in a walk on a sunny afternoon, by the thin shade of low dwarf birches, which had sprung up by the road side. In twelve or fourteen years, it grows to its usual height of twenty or twenty-five feet, and in this way better than in any other, can a profit be derived from otherwise useless land. It makes tolerable fuel, — less valuable, doubtless, than the wood of most other deciduous trees, and ranking with that of the evergreens, but answering

well, for the common purposes of the kitchen, for more than half the year. But it grows on poor land, where scarcely any thing else will, and on good land in a shorter time than any other tree, as on good land it may be advantageously cut every ten years. From the stem, or stump, spring several shoots, which push out in every direction and grow very rapidly. It makes a valuable coal for smiths.

All the birch trees, especially the black and the white, are so valuable for timber and for fuel that their cultivation should be earnestly recommended. They flourish on all kinds of soil, even the poorest, spring most readily from seed, and grow very rapidly. I therefore give, from Loudon's "Arboretum," two modes of propagating them, as practised in England, and on the continent of Europe. The directions have reference to the European birch, *betula alba;* but, from the intimate resemblance of the trees of the same family, will doubtless apply to our native birches. Indeed, Dr. Hooker says that, judging from the specimens of the little white birch which have been sent to him from this country, he cannot see how it differs, except in unimportant particulars, from the white birch of Europe.

"Birch seed ripens in September and October, and may be either gathered and sown immediately, or preserved in a dry loft, and sown in spring. If the seeds are to be sown immediately, the catkins may be gathered wet; but if they are to be kept till spring, they ought not to be gathered except when quite dry; and every day's gathering should be carried to a dry loft and spread out thinly, as they are very apt to heat when kept in sacks or laid up in heaps. The seeds should be sown in very fine, light, rich soil, in beds of the usual width, and very slightly covered. Boutcher says: 'Sow the seeds and clap them into the ground with the back of the spade, without any earth spread over them, and throw a little peas haulm over the beds for three or four weeks, till the seeds begin to vegetate. The peas haulm will keep the ground

moist, exclude frost, and prevent the birds from destroying the seeds.' (*Treat. on Forest Trees*, p. 113.) 'It is scarcely possible,' Sang observes, 'to cover birch seeds too little, if they be covered at all.' If sown in autumn, they will come up in the March or April following. If sown in spring, they will come up in May or June; which, in very cold climates like ours, is a preferable season. If any danger is apprehended from moisture in the soil during winter, the alleys between the beds may be deepened, so as to act as drains. In the nursery lines the plants require very little pruning, and their after-care, when in plantations, is equally simple.

"Young birch plants which have been pulled out of coppice woods when about two years old, are found to root much better than seedlings of the same age and size taken out of a regular seed-bed; doubtless because, in the latter case, a greater proportion of the taproot requires to be cut off. In the case of the young birches pulled out of the copses, the taproot, which could not get far down into the hard soil, has its substance in a more concentrated form, and is more branching: hence, little requires to be cut off it, except the ragged rootlets or fibres; and it may be considered as acting as a bulb to the upper part of the plant. The tops of these seedling birches are shortened before planting; and the plants, Mr. Young informs us, make as much wood in one year as regular nursery-reared birch seedlings will in two."

"In France and Germany, plantations of birch are frequently made by sowing the seed where the trees are intended finally to remain. For this purpose the poorest soils are harrowed in humid weather, in the month of October or of November; and fifteen pounds of seed, as it is taken from the catkins along with the scales, is sown on an acre, and afterwards covered with a bush harrow. . . . It is observed by Michaux, that burnt soil is peculiarly favorable to the growth of the birch, which in America reappears, as if by enchantment, in forests that have been burnt down." — *Loudon*, p. 1702.

EUROPEAN ALDER. *Alnus glutinosa.*

The growth of all the birches is so ready and rapid that they make perhaps the very best nurses for almost all other trees.

Sp. 6. The Dwarf Birch. *B. Glandulosa.* Michaux.

The dwarf birch is a handsome little shrub, not above two feet high, which is found far north on Hudson's Bay, and in mountainous regions as far south as New Jersey and Pennsylvania. It is found in a few places in this State, in wet meadows, on or on the sides of mountains.

V. 2. THE ALDER. *ALNUS.* Tournefort.

The alders are trees or tall shrubs, natives of the cooler regions of the northern hemisphere, and, in a few instances, of the mountains of tropical America and of Central Asia and Japan. Regel, in "Prodromus" (Vol. XVI.), makes fourteen species, six of which are found in America. They have alternate, entire, deciduous leaves, and stalked buds, in which the leaves, plaited and folded together, are protected by a single scale. The aments are on branched stalks, the male long, cylindrical, and pendulous; the female short, ovoid, and erect. The scales of the sterile aments are on stalks, with usually five smaller, accessary scales, and three-flowered. The flower-cup is four-parted, and has four stamens. The scales of the fertile ament are wedge-shaped, fleshy, and persistent; the ovary compressed, with two long stigmas. The strobile consists of woody scales grown together. The seed-vessel, or pericarp, is compressed, angular, woody, not winged, one-celled, and one-seeded.

The roots of the alders are large and strong, extending somewhat beneath the surface, with few radicles, and usually throwing up, near the stem, many suckers. They are covered with a thin, dark orange bark.

The wood is soft, somewhat tenacious, and durable under

water. It is, almost universally, of a reddish or pale rose color. The bark is thin, and parts easily from the wood when the sap is rising. The wood and the bark of the species found on the Eastern continent are extensively used for dyeing and for tanning, as the bark abounds in tannin.

The alder usually occurs along streams, and performs an important office in protecting their banks from the violence of the spring floods. It may be readily propagated by layers, by cuttings, by truncheons, or by seed.

The Common or White Alder of Europe is a very beautiful tree, sometimes rising to the height of seventy feet. It richly deserves transplanting in America, but must be planted only near the water, or in very moist land.

There are two species in Massachusetts: —

The Common Alder, remarkable for the glossy and often glutinous surface of the leaves, and for their being larger towards the end and rounded at the extremity; and

The Speckled, with large leaves, which are pretty thick, and have their lower surface downy or bluish white, or, rarely, green.

Sp. 1. The Common Alder. *A. serrulàta.* Willdenow.

Faithfully represented in Abbott's Insects of Georgia, II., Plate 92, with the American Alder Dagger Moth, whose caterpillar feeds on the leaves. The European is given in our Plate, as it is seen growing in the forest in Germany.

The common alder is a shrub or small tree, abounding along brooks and in swamps, rarely erect, but bending upwards. The branches are flexuose; when young, smooth or sometimes downy, and dotted with gray or orange oblong dots, brownish green, becoming afterwards a grayish or even a dark bottle green, with the dots longer and horizontal, and often sprinkled with a grayish dust, and here and there a thin lichen.

The leaves are alternate, on short, dotted, scaly footstalks, oval or obovate, rounded or somewhat acute or wedge-shaped

COMMON ALDER. (*Alnus serrulata.*)

at base, rounded or with a blunt point at the extremity, irregularly and slightly serrate, smooth and shining, with resinous dots, which on the young leaves are glutinous; they are sometimes sprinkled with white scales, and impressed at the veins above; on the under surface they are paler and shining, with the larger veins prominent, and with the veins downy while young, but at last nearly smooth, and with a tuft of down at the axils. They are coriaceous in texture, and from two and a half to four and a half inches long, and one and a half to three inches broad. The stipules form a purse enclosing the unexpanded leaf. They are yellowish green, coriaceous, broad-oval, rounded, half as long as the footstalk or more, falling off when two or three leaves above are expanded.

The flowers of the alder are among the earliest harbingers of spring. The aments, which had begun to appear towards the latter end of summer, had been perfectly formed before the close of autumn, and had so remained, unprotected, during winter, feel the first warmth, and expand early in April, or even in the last days of March. The aments of the male flowers are from one to three inches long, beautiful tassels of purple and gold, in clusters of three, four, or five together, on short, branching, terminal footstalks. They are composed of a central stem or rachis, to which are attached brown or purple, heart-shaped or rhomboidal scales, on short footstalks. Beneath each scale are three smaller ones, containing each a four-lobed flower-cup with four stamens, from whose anthers issues a cloud of pollen. The abundance of this golden colored dust gives its rich hue to the pale yellow flower.

The footstalks of the male and female aments part usually from the same point: the male hang downwards; the female stand erect, and seem to be terminal. The fertile aments are ovate-oblong, one fourth or one third of an inch long, of a deep purple; bristling, when in flower, with the prominent scarlet styles. They afterwards enlarge to one third or one half an inch in length, become very hard, and remain through the

winter on the tree, showing a distant relationship to the pines. Some of the scales of the ament often become excessively lengthened, leaf-like, or rather, like the stipules, bristling on the mature catkins, and at last turning black and hard.[1]

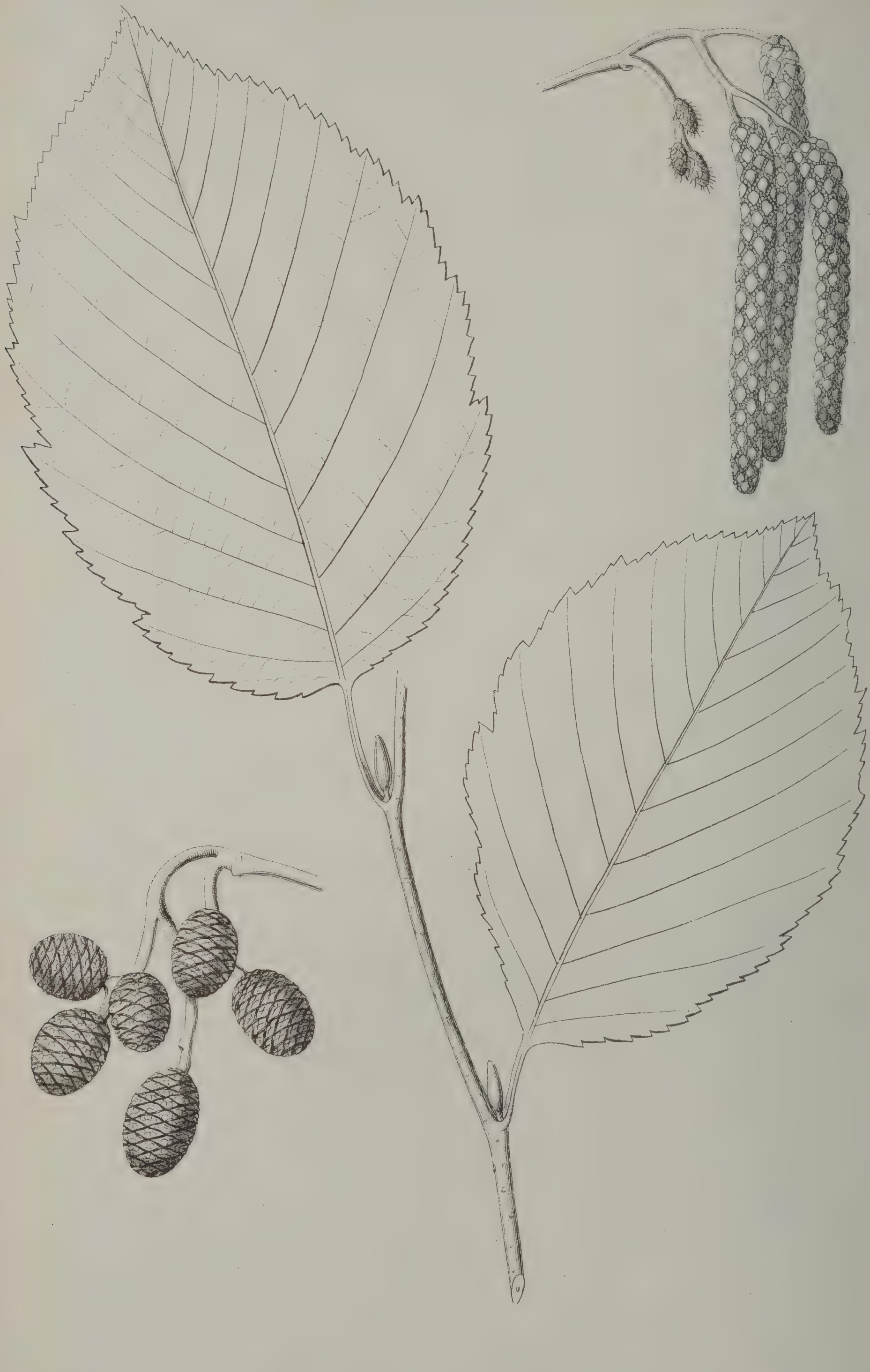
The wood is white, rapidly becoming orange, or of the color of Russia leather, on exposure to light.

In some countries, the alder has been planted for a purpose which it usually subserves without the aid of art, on the borders of rivers and small streams. The matted roots give stability to the banks of soft earth, and keep the stream within its bounds; while the stems, overhanging the water, beautifully fringe the meadows through which it flows.

The common alder is too small a tree to be much used for its wood, except as fuel, as it seldom grows more than twelve or fourteen feet high and two or three inches in diameter; though rarely, in deep swamps, it is found six or eight inches thick, and twenty or thirty feet high. It makes excellent fuel, burning readily, and throwing out much heat. It is preferred to any other tree, for making charcoal to be used in the manufacture of gunpowder. It is also employed for the hoops of small casks, such as are used to contain nails or gunpowder. There are many uses to which it might be put, as its close resemblance to the common alder of Europe indicates an identity of properties.

"In Scotland, the leaves of that alder have been used to tan leather and as food for sheep; and in France, as winter food for cattle. Ulcers have been healed by them, and a decoction has been found efficacious in the cure of sore throats. The bark, which is astringent, is used by fishermen to stain their nets; with copperas it forms a black dye, and, when

[1] The European Alder, *Alnus glutinosa*, is a very beautiful tree, which reaches, in perfectly wet situations, to the height of sixty or seventy feet. Its special use is for piles, which continue sound, in wet places or under water, for many years. It is therefore much used in Holland and Venice. It is also used for water pipes; and these, in time, become very hard, perfectly black, and the wood beautiful.



SPECKLED ALDER. (*Alnus incana.*)

concentrated, an ink; and it is used by the Laplanders to stain their shoes, girdles, and other articles of skin." — *Flora Londinensis, Art. Alnus.*

"The bark on the young wood, and the wood itself, is used for tanning; and the young shoots to dye red, yellow, and green." — *Loudon.*

Sp. 2. The Speckled Alder. *A. incàna.* Willdenow.

The leaf of the glaucous variety is figured in Michaux, II., Plate 75, figure 2.

This alder is found in every part of Massachusetts, and in Maine and New Hampshire.

The recent shoots and fruit-stalks are brown and downy, dotted with orange dots. They gradually become of an ashen or grayish brown where exposed to light; and, on the larger branches and trunk, in the shade, the bark is of a reddish or bottle-green color, speckled with conspicuous light gray dots; whence its common name of speckled alder. The stem is usually eight or ten feet high and from one to three inches in diameter; but it is sometimes much larger and higher, — twenty feet high and five or six inches in diameter.

The leaves are from three to five inches long and two to four inches wide, broad oval, rounded or somewhat cordate at base, pointed at the end, doubly serrate or denticulate-serrate (each of the larger veins usually forming a tooth with several serratures between), smooth and conspicuously impressed at the veins and veinlets above; of a soft coriaceous texture; covered with abundant, soft, often ferruginous pubescence beneath, with the veins and veinlets strikingly prominent. The opening leaves are very downy. The footstalk stout, half an inch long, and downy. Stipules lanceolate, downy, as long as the footstalk, soon falling.

The speckled alder is easily distinguished by the brilliant, polished, reddish green color of its stem-bark, and the size,

regularity, impressed reticulations, and the downy under surface of the leaves. The branchlets, at the time of flowering, are dependent; and the long, pendulous, sterile catkins are thus terminal, while the ovate fertile ones are on shorter, lateral footstalks just above. This is the reverse of the arrangement of the catkins in the common alder, in which the fertile aments, being erect, seem terminal; while the sterile ones bend down. The sterile aments are from one to three inches long, of an orange and brown color, more slender and tapering than those of the common alder. The fertile aments are cylindrical, smaller than those of the common, and pointing downwards.

This alder is found in the same situations and soil as the common, and seems to have similar properties.

A striking and very beautiful variety of the speckled alder, called the glaucous alder by the younger Michaux, is distinguished by the pale blue or glaucous color of the lower surface of the leaves. The pubescence is less abundant, but the veins and footstalk are often, as in the common form of the tree, of a rusty color. Michaux says that the glaucous alder sometimes becomes a tree of eighteen or twenty feet in height. He considers it a distinct species and the most beautiful of the alders.

There is a variety intermediate between the common and the glaucous alder, and more near to the latter. The leaves are oblong, doubly serrate, and distinctly pointed, rounded or acute at base; the veins slightly hairy or smooth, and the axils hairy. The young branches are brownish. It differs from the common alder in its leaves being always acute and never obovate, and from the speckled, in having its leaves shining and free from down. The leaves vary extremely in their proportions, being sometimes three or four inches long and one and a half inches broad, tapering at both extremities; and sometimes four or four and a half inches long and three and a half broad. They are thinner and less leathery

than those of the others. The fertile aments are on much-branched footstalks, often as many as twelve together.

The general aspect of this alder is similar to that of the speckled alder, differing in the greenness of the under surface of the leaves. It grows in similar situations, and is often ten or twelve feet high.

FAMILY VI. THE WAX MYRTLE FAMILY. *MYRICACEÆ.* LINDLEY.

A family of about thirty species[1] of leafy, aromatic shrubs with resinous glands and dots, and alternate, simple, entire leaves, found in all climates. It has a near affinity to the birch family; differing in its ovaries having only one cell, and in the character of its leaves. Some species produce eatable and agreeably acidulous fruits; the greater part have their fruit covered with tubercles of a resinous substance similar to wax. The species found in this country are low, fragrant shrubs, remarkable for their tonic, aromatic, and astringent properties. The male and female aments are on the same or on distinct plants: the male, cylindrical or thread-like, formed of bract-like scales, with from two to eight stamens in each flower; the female, ovate, sessile, densely imbricate; with ovaries one-celled, and containing one ovule, with two, long, thread-like stigmas. The fruit is a drupaceous, one-seeded nut.

We have two genera, the Myrtle, distinguished by its resinous or waxy berries; and the Sweet Fern, by its globular, compound fruit, with shining nuts set in bristling scales.

VI. 1. THE MYRTLE. *MYRICA.* L.

Male and female flowers on distinct plants. Scales of the aments crescent-shaped. Stamens four. Fruit drupaceous. Leaves wedge-lance-shaped.

[1] Cassini, in De Candolle's "Prodromus," makes thirty-eight species, seven or eight of which are found in America. He considers Comptonia as one species.

Sprague, del.

Armstrong & Co lith. 166 Congress St Boston.

2 BAY BERRY. (Myrica cerifera.)

SWEET GALE. (Myrica gale.)

3 SWEET FERN (Comptonia asplenifolia.)

Sp. 1. The Sweet Gale. Dutch Myrtle. *Myrica gale.* L.

Loudon's Encyc. 935. See our figure.

A dark-looking bush, from two to five feet high, growing in places which are inundated through a part of the year, and forming large, close-tangled patches or islets.

The branches and upper part of the stem are of a rich dark purple color, polished and shining. On older stems and lower, the outer bark cracks and rolls horizontally, becoming rough and of a lighter color, but still somewhat shining, giving the plant a resemblance to a black birch in miniature. The roots are somewhat matted together, and extend to some distance.

The leaves are from three to six fourths of an inch in length, and usually less than half an inch wide, wedge-lance-shaped, with a few serratures towards the extremity, which is commonly a little pointed; downy on the veins beneath, and sprinkled with minute, yellow, resinous dots on both surfaces.

Towards the end of summer the next year's aments are formed in the axils of the upper leaves, in the shape of short, ovoid, pointed, scaly buds. The male and female flowers are on separate plants. The male are in catkins an inch or more long, in twos or threes at the end of the branches. They are made up of heart-shaped, purple scales, loosely arranged on an axis. Each scale rests on a short footstalk, is striated within, has a membranous border, and is set, towards the base without, with numerous amber-colored, resinous dots. Stamens about four, at the base of the scale; the anthers are short, large, opening with four valves.

The fertile flowers are in ovoid catkins about a line in length, imbricate with triangular scales, from behind which appear the purple, tapering, thread-like, bifid stigmas. When mature, the compound fruit is in short, cylindrical aments, three or four lines long and three wide, sometimes solitary, but commonly in groups of two to six at the end of a short

branch. It is made up of ovaries surmounted by the withering styles, and compressed between two swollen, fleshy, three-sided, pointed scales, abundantly sprinkled with yellow, resinous dots.

When crushed, the leaves feel somewhat resinous, and exhale a strong, penetrating, rather unpleasant odor. They are often placed in drawers for the purpose of keeping out moths.

The young buds, Dr. Richardson says, are used by the Indians in Canada to dye their porcupine's quills. This plant is found in Labrador and Newfoundland, and as far as Fort Norman on the Mackenzie River. It is also found in Connecticut, Pennsylvania, and Virginia.

Sp. 2. The Bay Berry. Wax Myrtle. *Myrica cerifera.* L.

Figured in Bigelow's American Medical Botany, III., Plate 43; and by Mr. Sprague, in our Plate.

This is a crooked shrub, found growing in interrupted, miniature forests, in every variety of situation and soil, from dry, rocky hills to sandy plains and the borders of marshes. It is from two to six or seven feet high, very irregular, rarely erect, giving off crooked or angled, rough branches, in bunches of three or four. The bark is brownish gray, with clouds of a lighter hue, dotted with round, or oblong, horizontal, white dots. The leaves are irregularly scattered, often crowded or tufted, nearly sessile, obovate, lance-shaped, abruptly pointed, wedge-shaped at base, wavy, entire, or with a few serratures, sometimes revolute on the edge, and whiter and sprinkled with yellowish dots beneath. The barren flowers, which expand with the leaves in May, are in stiff, erect catkins, less than an inch long, on the sides of the last year's branches. The scales are roundish or rhomboidal, somewhat loosely arranged, and contain each three or four stamens, often partially united by twos, and surmounted by anthers divided to their base. The

catkins of the fertile flowers, which are on a different plant, are much smaller, erect, made up of imbricated, oval, pointed scales, containing an ovary surmounted by two prominent, awl-shaped stigmas. On each matured ament are from four to nine dry waxy berries or drupes, on very short footstalks. They are at first green, afterwards blackish, and finally white, consisting of a stone covered with black grains, invested with wax. The fruit-stalks continue to the second or third year, twelve or more arranged spirally on a shoot. The berries, leaves, and recent shoots are fragrant with a balsamic odor which seems to come from the minute, transparent, yellow dots with which the recent shoots and under surface of the leaves are sprinkled. The roots are large and somewhat spreading.

The wax is obtained by boiling the berries in water. It rises to the surface and hardens on cooling. About one third part of the weight of the berries consists of wax. In Nova Scotia, this wax is used extensively instead of tallow, or mixed with tallow, to make candles. It has sometimes, also, been mixed with beeswax for the same purpose. Candles made of it diffuse a very agreeable perfume, but give a less brilliant light than those made entirely of animal substance. The wax of the bay berry is also made into hard soap with the ley of wood ashes, lime, and common salt; one pound of wax being sufficient for ten pounds of soap, and taking the place of the animal or vegetable oils used in the manufacture of common soaps. A decoction of the root has been sometimes used as a remedy for dysentery.

VI. 2. THE LIQUIDAMBER. *COMPTONIA.* Banks.

Low shrubs with flagrant leaves, fern-like, long, slender, narrow, and deeply cut on both sides into roundish lobes, and globular, compound, bristly, bur-like fruits, with roundish, smooth nuts. There is a single species: —

The Sweet Fern. *Comptonia asplenifolia.* Aiton.

I. Sprague's figure in our Plate.

A fragrant, round-headed bush, about two feet high, abounding on hill sides and in the openings in woods. It has the appearance of a miniature tree. The recent shoots are green or of a yellowish or reddish brown, somewhat downy, and sprinkled, as are the leaves and stipules on both surfaces, and the older branches towards the extremities, with minute, yellow, shining, resinous dots. The branches of a year's growth are yellowish brown, with a polished, shining surface, somewhat hairy. The lower ones curve down and then upwards, forming an inverted arch. The older ones are reddish purple or coppery brown, rather rough, and closely dotted with raised, brown dots. The roots are long and creeping, and throw up numerous stems.

The leaves are nearly sessile, very long and narrow, from one to six inches long, and less than one inch wide, pointed, cut into large, obtuse-angled teeth, by indentations reaching nearly to the mid-rib, dark green, impressed at the veins above, paler and downy on the mid-rib and veins beneath ; with the margin somewhat reflexed. The stipules are half an inch long, lanceolate, acuminate, auriculate, or half-arrow-shaped, and often accompanied by an additional pair of smaller stipules below. The buds are small and roundish.

The barren aments are crowded towards the ends of the branches, in the axil of the sometimes persistent leaves of the last year. They are erect, sometimes more than an inch long, and somewhat pendulous when in flower ; composed of brownish, hairy, pointed, kidney-shaped scales, closely investing each other in spiral lines.

The fertile aments are, when young, oblong, one-third of an inch in length, becoming bur-like from the growth of the scales that surround the ovary, from among which project the thread-

like, crimson stigmas, and at length globular and bur-like, less than an inch in diameter, with a few ovate, smooth, shining, dark brown nuts, set among rough, narrow, awl-shaped, bristly scales.

The whole plant gives out a pleasant, spicy odor. This is stronger and somewhat different when the leaves are crushed. They are a common ingredient in diet drinks, and an infusion is a popular remedy for dysentery.

Dr. Richardson found the sweet fern in New Brunswick and in Canada as far as the Saskatchawan. It occurs abundantly throughout the New England and Middle States, and on the mountains of Carolina and Georgia.

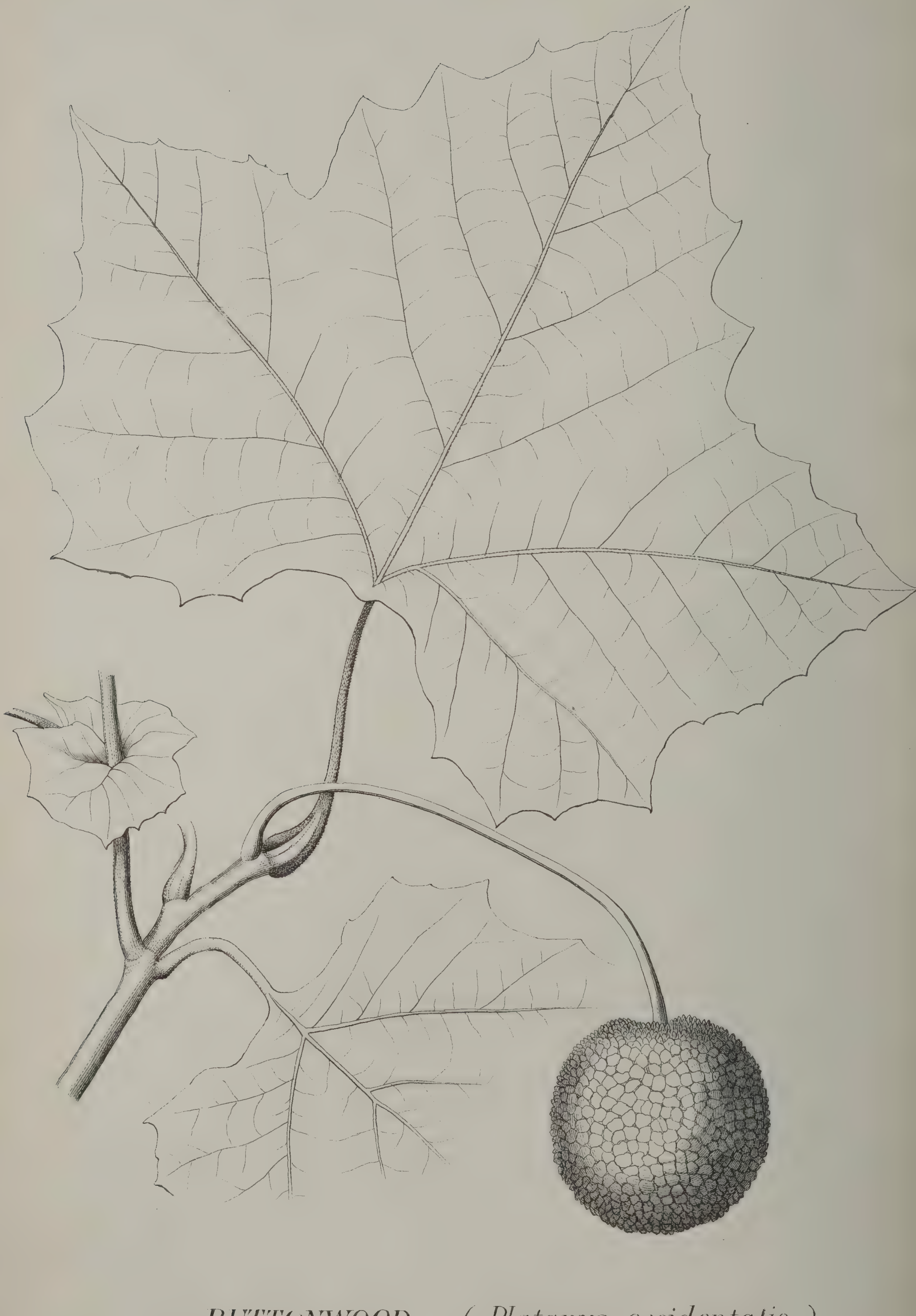
FAMILY VII. THE PLANE TREE FAMILY. *PLATANACEÆ.* LINDLEY.

The family of the plane trees comprehends some of the loftiest and largest deciduous trees of the northern temperate zone. They are distinguished for their broad leaves, globular inflorescence and fruit, and the absence of milk in leaves, fruit, wood, and bark. In some parts of the old continent they are valued for their timber, and have been, from ancient times, most highly esteemed for their shade. The leaf-buds are enclosed in the leaf-stalk, whence the planes are necessarily deciduous, the expansion of the buds forcing the previous leaves from their articulation. The layers of bark have little mutual adherence, and are deficient in toughness and extensibility; the outer layers are therefore liable to fall off in large irregular patches. The roots are long and running. By some writers the plane trees are considered as belonging to the Bread Fruit Family, with which they have many points of resemblance.

The planes are natives of the Levant, Barbary, and North America. The bark has some astringency, the leaves have been used in fomentations, and were formerly considered an antidote to the bite of serpents.

THE PLANE TREE. *PLATANUS.* L.

This is a genus, the only one of the family, of lofty trees, with broad, spreading branches, and large leaves, forming a dense foliage. The young shoots, leaves, and stipules are thickly covered with fine down, which, as they expand, falls off, and floating in the atmosphere, is liable to be inhaled by persons in their vicinity. This produces a disagreeable cough, sometimes of considerable duration; and the circumstance



BUTTONWOOD. (*Platanus occidentatis.*)

forms a strong objection to planting these trees in the neighborhood of dwelling-houses. A moth called *Sophiocampa tessellaris*, Checkered Tussock Moth, is found in great quantities, on the leaves of this tree. So are those of *Dryocampa imperialis* (Harris, p. 403, 404.)

Two species, the Occidental Plane, and the Californian, are found within the territory of the United States; a third, the Oriental, is generally diffused on the eastern continent; and two others, according to De Candolle (*Prodromus*, Vol. XVI., 159), occur in Mexico, and one in California. The only one native to Massachusetts is,

THE BUTTONWOOD TREE. *Plátanus occidentàlis.* L.

Figured in Michaux, Sylva, II., Plate 63; in Catesby's Carolina, Plate 56. The tree is represented, as seen in winter, in Loudon, Arb., VIII., Plate 289. The leaves are figured, together with the beautiful Plane Tree Moth, whose caterpillar lives on them, by Abbott, II., Plate 55; and by Audubon, with the Summer Duck; Birds of America, III., Plate 206. See our figures of the tree and of the leaves and fruit.

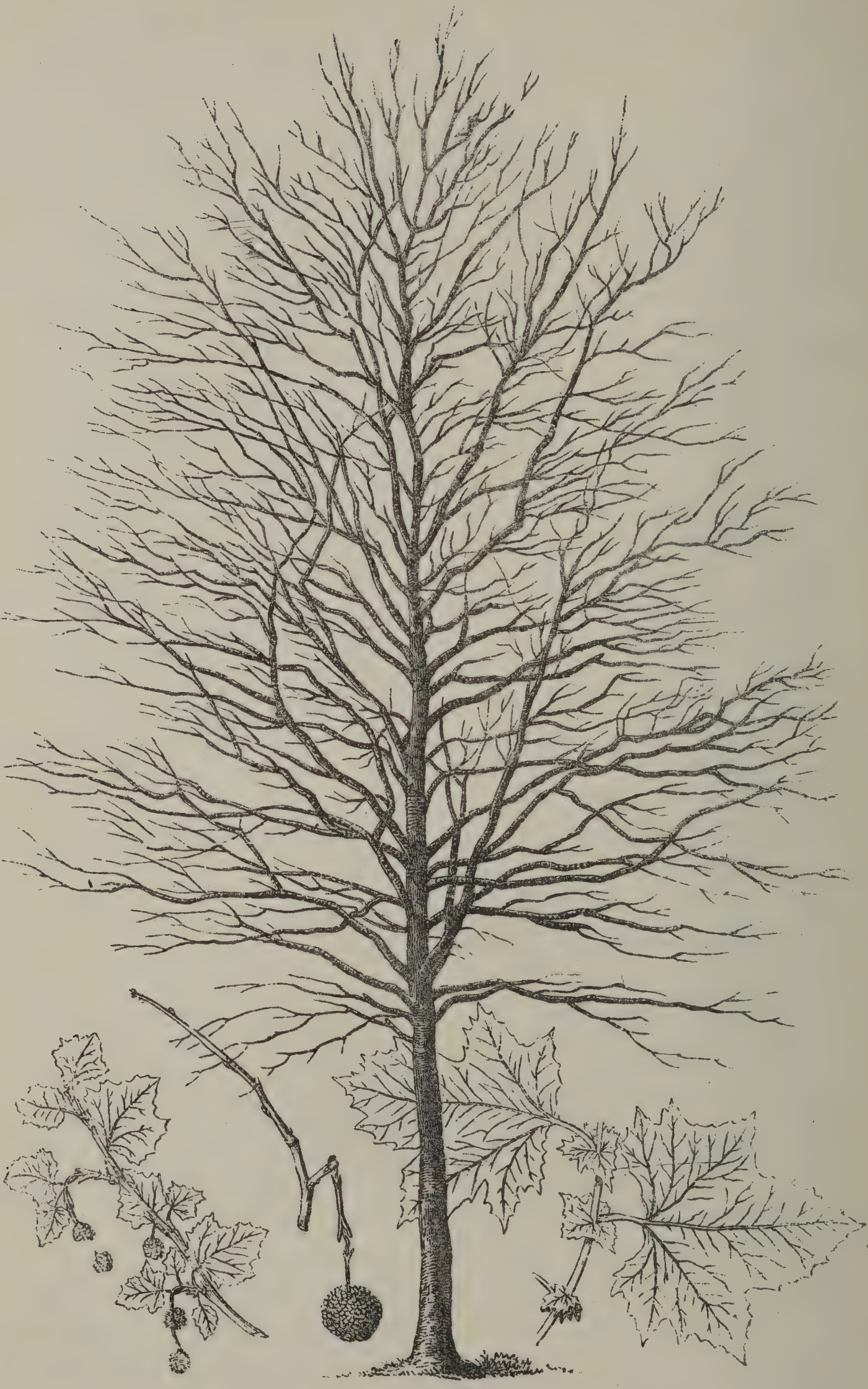
At a place called Vaucluse, some miles from Newport, on the island of Rhode Island, on an estate formerly belonging to Samuel Elam, a man of taste and of humanity, there was standing, in September, 1839, on the side of a small stream, a buttonwood tree, which measured, at one foot from the surface of the ground, twenty-four feet four inches. The thickness of the tree and the declivity of the bank, made the ground two feet and a half higher on one side than on the other, so that this measure was three feet and a half from the ground on the lower side. Four feet higher, it measured twenty-one feet four inches. At ten or twelve feet it divided into two trunks, which rose, parallel, to the height of not less than one hundred feet. In some aspects, it looked at a distance like a tree with one undivided trunk; in others, like two trees. Many moderately large branches thrown out far from the ground, gave it a long, cylindrical head. The root covered

the ground from four to eight feet on all sides of the trunk. In this horizontal pavement, some openings indicated decay; but in every other respect the tree had the appearance of perfect vigor.[1]

I fear that tree may not be now alive, as many of the finest plane trees have perished within a few years; if it is still standing, it is one of the most remarkable, for size and loftiness, in New England. Few trees are left of such gigantic dimensions as this. But still the plane is the largest, grandest, and loftiest deciduous tree in America. It has a magnificent columnar trunk. For a short distance from the ground it diminishes with a rapid, but regular, curve, which gives it a base of vast stability; thence, with a scarcely perceptible taper, a shaft rises high in the air, bearing its light green top aloft, above the summit of the other trees of the forest. The trunk presents a great variety of appearance. Rarely, it is seen with an ashen gray bark, cracked and rough, like other trees. But the bark has very little toughness; and usually, on the stem and larger branches, flakes off in broad, irregular scales, leaving portions of the inner layers, of a light yellowish color, exposed. These bright patches, seen among the green leaves, or on the uniform gray of the stem, produce a striking effect. Sometimes the upper part of the trunk is seen quite smooth, but of different colors, as there is no regularity in the period

[1] This horizontal expansion at the base is common in the plane tree of Europe. Olivier, speaking of the great plane tree of Buyuk-déré, a valley on the Dardanelles, six miles from the Black Sea, says, "Seven or eight trees, of an enormous size, adhering at their base, rise circularly, and leave in the middle a considerable space. A great many Greeks and Armenians were seated on the turf, in the shade of these trees, smoking their pipes. Several Turks were in the enclosure of the plane tree, smoking their pipes and drinking coffee."

"The plane tree often presents at its base a considerable expansion, of a diameter double or triple that of the trunk, and which may exceed thirty feet, as we have sometimes seen, so that it frequently happens when the tree dies of age, that it sends forth, all round the stump, shoots which form so many new trees; this, no doubt, is what has happened to the plane tree of Buyuk-déré. We remarked, indeed, that the seven or eight trunks of which it is formed, appear to have a common origin, and that they are all connected by their base." — *Travels in the Ottoman Empire, Egypt, and Persia.* By G. A. Olivier. London, 1801. Vol. I., pp. 114, 115.



AMERICAN PLANE. *Platanus occidentalis.*

or extent of the exfoliation of the bark. Sometimes the trunk is uniform and rough, with unequal roundish scales, while the limbs are smooth and mottled.

"No tree," says Gilpin,[1] "forms a more pleasing shade than the occidental plane. It is full leafed, and its leaf is large, smooth, of a fine texture, and seldom injured by insects. Its lower branches, shooting horizontally, soon take a direction to the ground; and the spray seems more sedulous than that of any tree we have, by twisting about in various forms, to fill up every little vacuity with shade. At the same time, it must be owned the twisting of its branches is a disadvantage to this tree, as it is to the beech, when it is stripped of its leaves and reduced to a skeleton. It has not the natural appearance which the spray of the oak, and that of many other trees, discovers in winter. Nor indeed does its foliage, from the largeness of the leaf and the mode of its growth, make the most picturesque appearance in summer.

"The oriental plane is a tree nearly of the same kind, only its leaf is more palmated; nor has it so great a disposition to overshadow the ground, as the occidental plane: at least I never saw any in our climate form so noble a shade, though in the East it is esteemed among the most shady and most magnificent of trees."

The recent shoots are overspread with a copious grayish down, which they lose, in the course of the first season, except about the nodes or joints, and become of a grayish purple, or chestnut brown. The next year they are smooth and of a greenish gray, thickly scattered with minute gray dots. The green tinge gradually fades, and they assume a uniform light gray or yellowish color, almost white, as seen from a distance. The leaves are on stout footstalks, which are two or three inches long, very downy and grayish green at first, but becoming nearly smooth and purple. At the base of the leaf, the footstalk subdivides by throwing out two opposite ribs, nearly

[1] *Forest Scenery*, I., 109, 110.

as large and long as the mid-rib, each of which has a large branch below, dividing the leaf into five imperfect lobes, and giving it a pentagonal outline. The ribs and veins are very prominent on the under surface, and each terminates in a large tooth. When freshly expanded, the leaves are profusely covered with a cottony down, which gradually disappears, and in autumn the upper surface is perfectly smooth, and of a light yellowish green; the under surface is lighter, and still covered with down along the prominent purple ribs and veins. A striking feature in the appearance of the buttonwood is formed by the very large, conspicuous, and persistent stipules, with which every growing branch is garnished. These are always leaf-like, sometimes distinct, one on each side of the base of each leafstalk, oftener grown together, forming a complete ruffle, encircling and more than encircling the branch, and embracing it with a sort of sheath. When distinct, they are two or three inches long, an inch and a half broad, pointed, and, like the leaves, conspicuously toothed. When grown together, they look like a leaf whose extreme point is on the side of the branch opposite the leaf of which they are an appendage. Above them, especially at the base of a branchlet, is often found an additional pair of lance-shaped stipules, or a single one, two or three inches long. Both these kinds of stipules are, on the vigorous shoots, particularly on the sprouts from the stole, or root, more lasting than the leaves; not being pushed off, like them, by the growth of the buds. The leaves are usually five or six inches long, and seven or eight broad; but they are often much larger. Before falling, they turn usually to a pale yellow.

The buds are short, broad, pyramidal, rounded at the tip, and of a chestnut brown when they have been a little while exposed. They are enveloped by several gummy scales, and, in their early stage, enclosed in the footstalk of the leaf, which is therefore necessarily deciduous. Each bud and the base of each branchlet are accordingly surrounded by the scar of a

fallen leaf, and the branchlet is encircled at that point by a ridge formed by the scar of the pair of stipules; whence the smaller branches have a jointed appearance.

The female catkins are a globular ball, five-eighths of an inch in diameter, at the end of a flexible, downy footstalk, which is from two to five inches long, and one-eighth of an inch in diameter. The styles are in twos — or, if double, cleft to the base, completely investing the ball, close-set, swelling and hairy at base, tapering, green, with a small, declined head, and a reddish, glandular fringe on one edge as a stigma.

The young leaves are accompanied by a pair of short, brownish, sheathing, scale-like, deciduous stipules, and, with their footstalks, are covered with a thick cottony down.

The male catkins are on slender, tapering, dusty threads, one or two inches long. They are one-quarter of an inch in diameter, and are invested by numberless stamens, completely in contact, each consisting of two cells, opening at the sides, white, and pouring out white pollen, and surmounted by a brownish green, glandular disk, forming together the surface of the ball. The footstalks of the catkins have stipules at base, like those of the leaves, but smaller; those of the female often having one or two miniature leaves, and a peculiar auricular appendage towards the base, as if they were abortive branches. When mature, the balls are an inch or less in diameter, perfectly round, and containing innumerable very minute seeds, each provided with a delicate tuft of hair-like wings, on which they fly to a distance in the spring.

In most parts of New England, this tree is called buttonwood by the common people. Sycamore is a name often given to it; and it is sometimes called the plane tree. In England it is called the occidental plane, to distinguish it from the European, which is called the oriental. There is no propriety in calling it sycamore, as that name indicates a totally different tree. Plane tree, or platane, is classical; but buttonwood is the good, English, descriptive name which belongs to it.

According to Michaux, this tree is found as far north as Montreal, in Canada, where it is called by the French, the cotton tree. Along the coast, I have found it in the county of York, in Maine. Its range southward is beyond the Mississippi, and in longitude from the Atlantic, through the extreme Western States. It flourishes best on a deep, loose, rich soil, in a cool, moist situation ; and it is nowhere more vigorous than along the rivers of Pennsylvania and Virginia, and especially on the Ohio and its tributaries. The elder Michaux measured a buttonwood growing on a little island in the Ohio, fifteen miles above the mouth of the Muskingum, and found its girth, at five feet from the ground, to be forty feet four inches. General Washington had measured the same tree twenty years before, and found it to be of nearly the same size. In 1802, the younger Michaux and his companions, found a large tree of this kind on the right bank of the Ohio, thirty-six miles from Marietta. Its base was swollen in an extraordinary manner ; but, at four feet from the ground, its circumference was found to be forty-seven feet.

The buttonwood is remarkable for the rapidity of its growth, especially when standing near water. Loudon mentions one which, standing near a pond, had, in twenty years, attained the height of eighty feet, with a trunk eight feet in circumference at three feet from the ground, and a head of the diameter of forty-eight feet. The buttonwood has been cultivated in England more than two hundred years, having been introduced about 1630. In 1809, it had become more common than the oriental plane ; but in May of that year a severe frost is supposed to have killed the young shoots of many of the largest trees of this species throughout the Island. In Scotland, where trees of both species were growing near each other, the oriental escaped, while the occidental were generally injured. Many died that year, or in the summer of 1810, after making an ineffectual effort to push their leaves. According to the observation of Lang, only the large trees per-

ished. But the severe winter of 1813–14 destroyed many of those which had escaped in 1809.

It seems very doubtful, from the account given of this malady, whether it is referred to its true cause. Lang says, "Trees from twenty to twenty-five feet in height were little hurt; and smaller ones not at all." This looks very little like the action of frost.

The buttonwoods, throughout New England, were affected in a similar manner, but less severely, in the springs of 1842, 1843, and 1844. The shoots seemed to have been nipped as by a frost. The large trees were particularly affected, but by no means exclusively. For some weeks, in each of these springs, many of the trees seemed to have been killed. In the course of the summers, most of them have pushed forth leaves on the sides of the branches, and have seemed partially recovering. The extremities of the branches, on almost all the buttonwoods, are dead, and many of the trees are now, in the fall of 1845, completely so.[1]

This malady has been attributed to various causes. By most persons, it is considered the effect of frost. Others ascribe it to the action of some insect or worm; and others believe it to be some unaccountable disease. It seems to me most probable that it is owing to the tree's not maturing its wood during the previous summer, so that it is incapable of resisting the cold of winter. The present season, of 1845, has been a remarkably warm one; and this year, if ever, the buttonwood must have had time to mature its wood. If the wood formed during the present season should not be affected by the cold of the spring of 1846, some confirmation will be given to this conjecture.

Very little use in the arts is made of the wood of the plane tree. It is very perishable when exposed to the weather; it is said to warp considerably; and in every valuable property

[1] In 1874, they look better than in 1845; but they have not recovered their health and beauty. Very many have died; and many others have been cut down. I retain my opinion of the cause; but I may be mistaken.

is thought to be surpassed by other kinds of timber equally abundant and accessible. For some purposes of ornament, however, it would seem to present claims to attention. The roots, according to Michaux, have a beautifully red color, when taken from the earth, but lose it on exposure to the light. Means might doubtless be found to make this color permanent. The wood of the stem is hard, of a firm and close texture, of an agreeable, faint red color, and beautifully varied by close lines of silver grain. There is every reason to believe that it is as valuable as that of the oriental plane, and that the great excellence and variety of our timber trees have alone prevented the necessity of its use.

S. W. Pomeroy, Esq., in an article in the fifth volume of the "New England Farmer," urges the cultivation of the buttonwood. He says it may be propagated with more ease than any tree of the forest; and the speedy returns of fuel it will make, lead him to believe that its cultivation would become general, if its value were duly appreciated. The wood of buttonwood trees grown in moist situations burns very ill when green; but when it grows on dry, sandy, or rocky soils, it burns as freely, when green, as oak cut at the same time. It is not, he thinks, equal to the best kinds of fuel; but it is superior to chestnut, and makes excellent charcoal. "It is a very valuable fuel for stoves. Perhaps it may be ranked with the best kinds of soft maple. If the question is, What kind of tree, on land of the same fertility, will furnish fuel which will give the greatest amount of caloric? he says, "I do not hesitate to declare my perfect conviction, that it (the buttonwood) will furnish results much more favorable than any tree our country produces, except the locust, on dry soils."

There are many remarkable trees of this kind in various parts of the State. An old hollow tree near the little bridge over the south branch of the Nashua, in Lancaster, bending over the water, was, in 1840, sixteen feet ten inches at the ground, fifteen feet nine inches at three, and fourteen feet

ORIENTAL PLANE TREE. *Platanus orientalis.*

nine inches at six feet. A second near it and vigorous was, at the same heights, respectively, sixteen feet eleven inches, thirteen feet six inches, and thirteen feet four inches. A third, an opening at the foot of which showed that it was extensively decayed at the centre, was twenty-three feet two inches at the ground, eighteen feet six inches at three feet, and eighteen feet two inches at six, just above a small branch. This is a magnificent tree, holding its size for twenty feet, and, though inclining towards the north-east, sustaining a broad, cylindrical, and noble head, of great height. At West Springfield, I measured, in 1838, one by the road-side, which I found to be sixteen feet six inches at four feet from the ground.

The oriental plane tree holds the same place on the Eastern continent which our buttonwood does on this. It differs from the occidental, as has been already said, in having a more palmate leaf and a less umbrageous head. Yet it was the greatest favorite among the ancients. Cimon sought to gratify the Athenians by planting a public walk with it. It was considered the finest shade tree of Europe, and, in many places, it is still so considered.

Pliny expresses his admiration that a tree valuable only for its shade should have been introduced from a distant part of the world. He tells the story of its having been brought across the Ionian Sea to shade the tomb of Diomedes, in the island of the hero; that it came thence into fertile Sicily, and was among the first of foreign trees presented to Italy; and that, too, as early as the taking of Rome by the Gauls. From Italy it was carried into Spain, and even into the most remote parts of then barbarous France, where the natives were made to pay for the privilege of sitting under its shade.[1] No tree was

[1] Sed quis non jure miretur, arborem umbræ gratia tantum ex alieno petitam orbe? Platanus hæc est, mare Ionium in Diomedis insulam ejusdem tumuli gratia primum invecta, &c. — *Plinii Sec. Nat. Hist.*, XII., 3.

Who would not naturally wonder that a tree should be sought for in a distant part of the world, only for the sake of its shade? But such is the plane tree, brought first across the Ionian Sea to the island of Diomedes, to shade his tomb.

ever so great a favorite with the Romans. They ornamented their villas with it, valuing it above all other trees for the depth of its salutary shade in summer, and the freedom with which it let in the winter's sun. They nourished it with pure wine;[1] and Hortensius is related to have begged of his rival, Cicero, to exchange turns with him in a cause in which they were engaged, that he might himself do this office for a tree he had planted in his Tusculanum.[2]

Pliny describes some of the most remarkable planes. In the walks of the Academy, at Athens, were trees whose trunk was thirty-three cubits (about forty-eight feet) to the branches.[3] In his own time, there was one at Lycia, near a cool fountain by the road-side, with a cavity of eighty-one feet circuit within its trunk, a forest-like head, and arms like trees overshadowing broad fields. Within this apartment, made by moss-covered stones to resemble a grotto, Licinius Mucianus thought it a fact worthy of history that he dined with nineteen companions, and slept there too, not regretting splendid marbles, pictures, and golden-fretted roofs, and missing only the sound of rain drops pattering on the leaves.

In more modern times, the Persians have shown an equal partiality to the plane tree, which they call the chinar. Avenues and rows of this tree intersect their gardens; beneath them they love to enjoy the cool breeze, and here they worship; and they, or travellers among them, ascribe the virtue of protection from the plague to great numbers of these noble trees planted near their dwellings at Ispahan.[4]

[1] Martial wrote an epigram to Cæsar's plane at Tartessus, on the Bœtis, the jewel of his palace:—

> Ædibus in mediis totas amplexa Penates
> Stat platanus:

To its other honors he adds—

> Crevit et effuso latior umbra mero.—*Epig.*, IX., 62.
>
> Its shade became more broad from its being watered with wine.

[2] Macrobius Saturn, II., 9.

[3] So I understand "cubitorum xxxiii., a radice ramos antecedente."—*Nat. Hist.*, XII., 5. The annotator thinks otherwise.

[4] Evelyn.

In the Levant, in Persia, and in other parts of Asia, where timber trees are few, and where the oriental plane is the commonest of trees, it is much used in carpentry, joinery, cabinet-making, and even in ship-building. Olivier says,[1] "The plane tree grows naturally throughout all the East: it is common on the banks of the rivulets in Greece, in the islands of the Archipelago, on the coast of Asia Minor, in Syria, and in Persia." "Its wood is not inferior for cabinet-work to any wood of Europe; it takes a beautiful polish, and is very agreeably veined;" and "the Persians employ no other for their furniture, their doors, and their windows." That it has a beautiful surface and a very smooth grain; and that it takes a brilliant polish, is seen in the famous Scotch snuff-boxes, which are made of it.

Mr. Nuttall has described[2] a remarkably distinct species of plane tree, which he calls the California buttonwood, *Platanus racemòsus*. The leaves are "divided more than half way down into five sharp-pointed, lanceolate portions, of which the two lower are the smallest; all the divisions are quite entire, two of them in small leaves are suppressed, thus producing a leaf of only three parts. Above, as usual, the surface is at first clad with a yellowish, copious down, formed of ramified hairs, which quickly falls off and spreads itself in the atmosphere. The under surface of the leaves is, however, always copiously clad with a coat of whitish wool, which remains. The young leaves, clad in their brown, pilose clothing, have a very uncommon appearance, and feel exactly like a piece of stout, thick, woollen cloth. The branchlets, petioles, and peduncles are equally villous. The male catkins are small, less in size than peas, full of long-haired scales, and with unusually small anthers. The female catkins are in racemes of three to five in number, with remarkably long styles (being between two and three tenths of an inch in length), and persistent on the

[1] *Olivier's Travels*, I., 116.
[2] *Nuttall's Supplement to the N. A. Sylva*, I., 47, 48.

ripe balls. The raceme, with the full-grown balls, measures nine inches. The tree has, therefore, a very unusual appearance, filled with these very long, pendulous racemes, each bearing from three to four, or even five, balls, at the distance of about an inch from each other. The stigmas are at first of a deep and bright brown." Mr. Nuttall supposes the wood to be superior to that of the common species; harder, more durable, and less liable to warp.

The leaves and fruit of this tree are figured in Nuttall's "Supplement to the North American Sylva," I., Plate 15; and in Audubon's "Birds of America," Plate 362.

The plane tree may be propagated by seed, by layers, or by cuttings. The best and surest way is by seed. These are ripe, in our climate, in October or November. They may be readily separated from the globular aments by beating, or by the hand. By rubbing, they are then made clear of the wool. Mr. Cobbett, who raised many plants from seed, soaked it in lukewarm water for forty-eight hours. He then mixed it with finely sifted earth, ten gallons of earth to one of seed; put the mixture upon the smooth, bare ground; "turned and remixed the heap every day for four or five days, keeping it covered with a mat whenever the turning and mixing were not going on; and, as soon as a root began to appear here and there, sowed the seeds upon a bed of sifted earth, mixed with the sifted mould, just as they came out of the heap." No other covering was given; they were carefully watered and kept shaded, and in about a week germinated and showed their seed-leaves. This was in April. The plants were gradually inured to the sunshine, and in October their wood was ripe. In the succeeding summer they were fit to transplant into nursery lines.[1]

General H. A. S. Dearborn, so well known for the skill and success with which he has cultivated forest trees, gives, in the "New England Farmer," Vol. V., p. 193, valuable directions

[1] *Woodlands,* as quoted by Loudon.

for raising buttonwoods. He says the balls should not be gathered before the fall of the leaves; or, still better, not till March. He sowed the seeds in the spring, broad-cast, very thick, in a rich seed-bed of fine, light, carefully prepared mould. They were raked in and covered, and the ground was left smooth and level. When the plants first appear, they are very tender, and must therefore be screened from the heat of the sun for several months, by mats, or by brushwood thrown over poles resting on crotched stakes, two or three feet from the ground. He has usually transplanted them, when a year old, into a nursery; placing them a foot apart, in rows three feet asunder. "The seed-bed should be kept clear of weeds, and the ground in the nursery, between the rows, dug over every spring, and often hoed and raked." When three or four years old, the plants may be removed, and set wherever they are wanted for shade, ornament, or fuel.

FAMILY VIII. THE WILLOW FAMILY. *SALICINEÆ.* ENDLICHER.

The willows and poplars form an eminently natural family, of striking properties and extensive and important uses. They are lofty or spreading trees, or low, slender shrubs, occupying the cooler parts of both hemispheres. One of the willows, *Salix arctica*, is found farther north than any other woody plant; and they extend southward into Africa, a single species being found in Senegal. This family has always been one of the most important to mankind. Several species are valuable for their wood, and as affording materials for many of the arts; and the bark of all has important astringent and tonic properties. The bark of the common poplar, the round-leafed aspen, has been used in this country as a febrifuge; and from that of several species of willow — *Salix Russelliana*, *Helix*, and others, most of which are naturalized in this country — a substance called *salicine* has been extracted, possessing the best virtues of the extract from Peruvian bark. The buds of the balsam poplar, or Balm of Gilead, have reputation as a vulnerary. They yield a resinous substance, which is collected in shells, and imported for medicinal purposes into Europe from Canada. A similar substance, resembling storax, and said to possess diuretic and antiscorbutic properties, is yielded in less quantity by the fragrant buds of the white and tremulous poplars of Europe. The bark of the willow contains, according to Sir Humphrey Davy, as much of the tanning principle as that of the oak; and the leaves of one species are used in Iceland for tanning leather; and the bark of another, in Sweden, Switzerland, and Scotland, for tanning, and for dyeing black. The twigs, the young trees, the wood, and the outer and the inner bark, have been used, in all periods, for

the greatest variety of purposes — for cords, ropes, baskets, and hurdles, as material for cloth, for the food of domestic animals, and even of man. For in Kamtschatka the inner bark is sometimes made into bread; and the leaves of the goat's willow, *Salix caprea*, are considered in France, at the present day, as they were anciently in Italy, the best food for cows, goats, and horses.

Both willows and poplars are remarkable for the size and length of their roots, for their fondness for water, and for their tenacity of life. All the species of both genera are easily propagated by cuttings; and most of them, planted by river sides, serve, like the alders, to protect the banks from being worn away by the action of the stream; and, from the rapidity of growth, and the hardiness of many of the species, they are admirably adapted to act as nurses to more tender trees in exposed situations.

The family is distinguished by the following characters: The sterile and fertile flowers are on distinct plants. Both are disposed in many-flowered aments, each flower being supported by a bracteal scale. The ovaries are solitary and one-celled, with many ovules. The stigmas are two. The fruit is a one-celled, many-seeded capsule, opening with two valves. The seeds are very minute, erect, attached to the inner surface of the valves, and circled by a tuft of very long, cottony down. The leaves are alternate.

The genera are two, the Poplar and the Willow. They are distinguished by the general appearance of their leaves, which, in the poplar, are roundish or triangular in outline; in the willow, usually long and narrow; and by the number of stamens, which are from two to seven in the willow, and from eight to thirty or more in the poplar, and set in a little cup, protected by a jagged scale.

VIII. 1. THE POPLAR. *POPULUS.* L.[1]

The poplars are large trees, with alternate leaves, and, while young, a smooth, leather-like bark. The buds are more or less invested with a fragrant, viscid balsam.[2] The leaves are large, roundish or triangular in outline, and set upon a long footstalk, which is laterally compressed towards the leaf, whence the leaves have their characteristic, tremulous motion when agitated by the wind. The footstalks are often set with glands. The flowers come out before the leaves, from scaly buds. They are disposed in cylindrical aments, and composed each of a scale deeply cut or torn at the edge. Beneath each scale in the sterile ament is an oblique, cup-shaped scale, containing from eight to thirty or more short stamens. The similar scale in the fertile flower contains a single ovary, crowned with two bifid stigmas. The matured ovary becomes a capsule, which opens with two valves, disclosing the numerous minute seeds cinctured with a silken or cottony crown. The sterile aments, making their appearance before the leaves, and when few flowers are to be seen, are striking objects from their size, and the rich red color of their very numerous stamens.

The trees of this genus are all of very rapid growth, especially in moist situations, by the sides of running streams; and they are remarkable for the readiness with which they may be propagated by cuttings or layers. They also grow readily amidst the dust and smoke of close and crowded towns. They may thus be planted by persons totally unacquainted with arboriculture, and, in situations where no other tree will flourish,

[1] Wesmael, in De Candolle's "Prodromus," Vol. XVI., p. 323, describes eighteen well ascertained species of poplar; of which six are European, four or five Asiatic, one African, and nine North American.

[2] This the bees gather to form therewith the propolis with which they mend, perhaps construct, their hives.

BLACK POPLAR. *Populus nigra.*

will, in a surprisingly short time, exhibit a pleasant object, and exclude disagreeable ones. Evelyn calls the poplars "hospitable trees, for any thing thrives under their shade."

The wood was used by the ancients for the purpose of making bucklers, as it is very light and somewhat tough; and thence it is not broken, pierced or splintered by a blow, but only indented. "The wood of the poplar is soft, light, and generally white or of a pale yellow. It is of but little use in the arts, except in some departments of cabinet and toy-making, and for boarded floors; for which last purpose it is well adapted, from its whiteness and the facility with which it is scoured, and also from the difficulty with which it catches fire and the slowness with which it burns. In these respects, it is the very reverse of pine. Poplar, like other soft woods, is generally considered not durable; but this is only the case when it is exposed to the external atmosphere, or to water; and hence the old distich, said to be inscribed on a poplar plank, —

> 'Though heart of oak be e'er so stout,
> Keep me dry, and I'll see him out,'

may be considered as strictly correct."[1]

The Trembling Poplar (aspen), represented by figure opposite, is the common poplar of Britain. The Nigra (black) is the beautiful poplar of the south of Europe and Germany.

Insects on the Poplars. — The large, pea-green, stinging caterpillars of the moth called *Saturnia Io*, feed on the leaves of the balsam poplars, as well as on those of the elm, the cornel, and the sassafras. (Harris, p. 395.) The caterpillar of the *Cerura borealis*, remarkable for his odd appearance and horned tail, and thence called the horn-tailed caterpillar, also feeds on the several species of poplar. The caterpillars of the *Antiopa* butterfly are found in great numbers on the poplars, the willows, and the elm, and commit great ravages on their leaves (ib. p. 296). So do the spinning caterpillars

[1] Loudon, Vol. III., p. 1637.

of the *Clostera Americana* (ib. p. 431–33), and the caterpillars of the herald-moth. Still more serious injury is done by the boring grubs of the beetle called *Saperda calcarata*, and those of the *Prionus laticollis* (ib. p. 106.) The former live in the trunks, the latter in the trunks and roots of the various kinds of poplar, native and foreign (ib. p. 80).

Four species of poplar are native to Massachusetts, the Large Poplar, the American Aspen, the Balm of Gilead, and the River or Smooth-leaved Poplar. Two other species have been extensively introduced, the Lombardy Poplar, and the White Poplar.

Sp. 1. The Large Poplar. *Pópulus grandidentáta.* Michaux.

The leaf and fertile ament figured in Michaux, Sylva, II., Plate 99, fig. 2. See our Figure.

This is a tall, erect tree, covered with a smooth bark of a soft, light, greenish gray color. The branches are small, and, although they go out at a large angle, rarely form a broad head. The bark on the young branches is dark, but soon takes the uniform, leather-like appearance of the trunk. It is remarkably smooth, but in very old trunks cracks a little.

The buds are conical, more obtuse than those of the aspen; scales not glossy, but somewhat downy; stamens eight to twelve; cup hairy; stigmas linear, carmine red.

The leaves, which are often in tufts at the ends of the branchlets, are roundish, with from five to nine large, blunt teeth on each side, smooth on both surfaces, and paler beneath. The footstalk is slender, compressed laterally, two-thirds as long as the leaf. The buds are conical.

This tree is found abundantly growing in the forests in the western and northern parts of the State; in which situation it rises to the height of seventy or eighty feet, with a diameter of from sixteen to twenty-four inches, and forms a small, roundish head at the general level of the tops of the trees.

LARGE POPLAR. (*Populus grandidentata.*)

When growing on the edge of a wood or lake, or by itself, it is commonly forty or fifty feet high, with an open and rather graceful head ; forming a beautiful object from the soft green of the trunk, the lightness of the branches, and the mobility of the foliage. The wood is soft and light, and of no great value.

When, in the time of our grandmothers, fashion required that a lady should seem somewhat taller than nature made her, the light wood of this poplar was in demand, as best adapted for the substance of the high heels of their shoes; and the manufacture constituted a distinct trade. The more substantial heels of the shoes of the lower people were made of more durable and heavier maple. The wood was also extensively used in the manufacture of hats, before the palm-leaf was introduced.

When dry, it is considered equal to pine as fuel; and, as the tree grows readily and rapidly, it might well be planted for this use. This poplar is found from New Brunswick and the borders of Lake Huron, through the New England and Middle States, to the mountains of Georgia.

Sp. 2. The American Aspen. *P. trémuliformis.*[1] Michaux.

A leaf and sterile ament are figured in Michaux; Sylva, II., Plate 99, fig. 1. See Sprague's Figure.

This is a small, graceful tree, from twenty to forty feet high, with a gradually tapering trunk, and small branches, moderately spreading. The trunk is covered with a white, clay-colored bark, with long blotches of very dark brown, particularly below each branch, in a triangular space, from the upper angle of which the branch issues.

[1] The word *tremuloides,* as Mr. E. Tuckerman has remarked, is a barbarous compound of Latin and Greek, and ought not to be retained. *Tremuliformis* is the word which Michaux should have used, as he meant to express the resemblance which our aspen has to the *P. tremula.*

The recent shoots are of a dark, polished bronze green, which is gradually changed, by the influence of light, on the larger branches, to the clay color for which the trunk is remarkable. The branches are, therefore, darker colored beneath. The leafy branchlets are short, and go off at a large angle.

The buds are long, sharp-pointed; the scales smooth, glossy, covered with varnish.

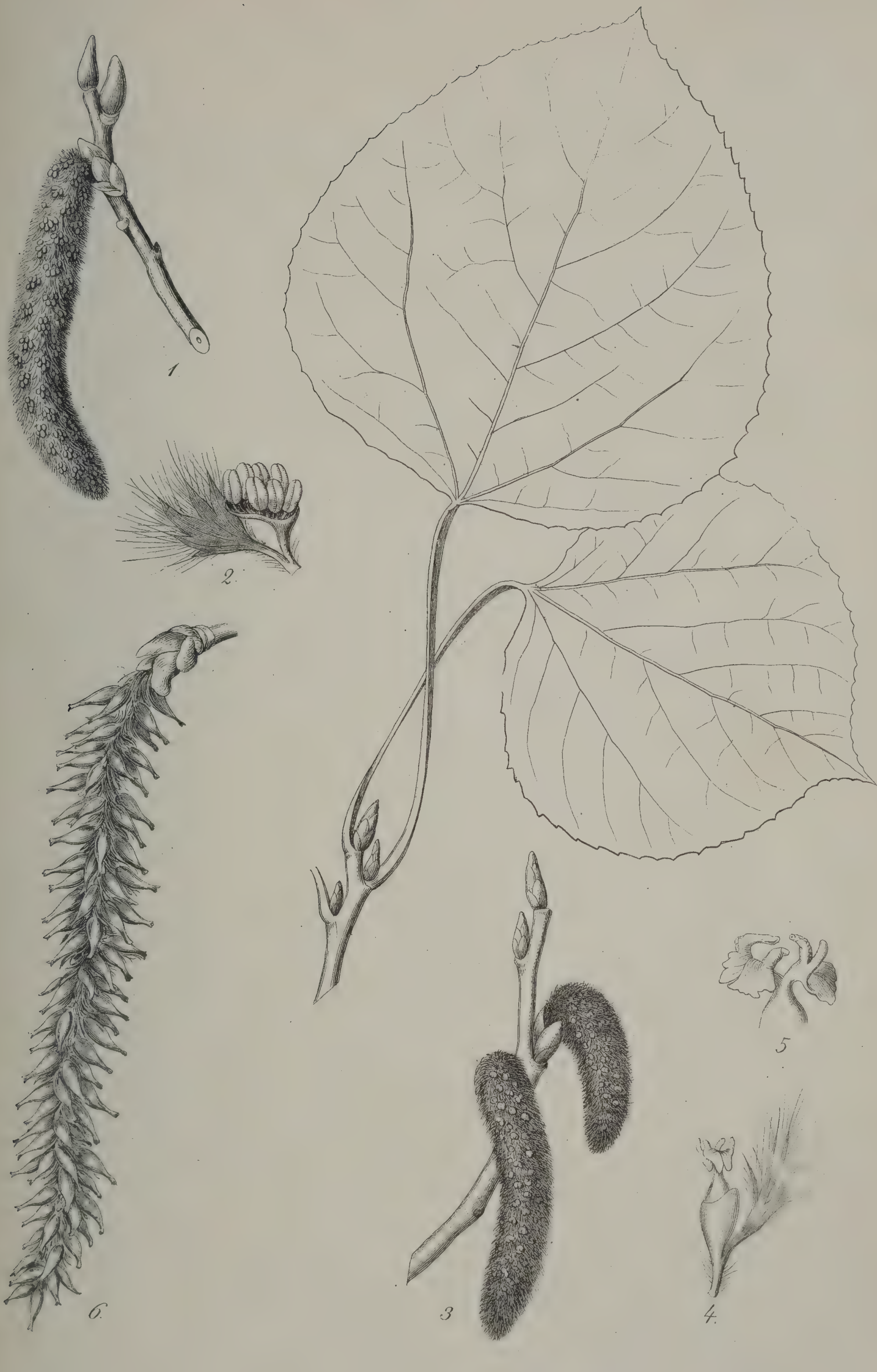
The leaves are round in their outline, about two inches long and of equal breadth, somewhat heart-shaped at base, abruptly acuminate, with a wavy, toothed border, covered with soft silk when young, which remains only as a fringe on the edge at maturity; supported by a very slender footstalk about as long as the leaf, and compressed laterally from near the base. They are thus agitated by the slightest breath of wind, with that quivering, restless motion characteristic of all the poplars, but in none so striking as in this. In this respect, it bears a near resemblance to the European tree, after which it is named, and which has given occasion to so many poetical and satirical allusions: whose leaves Gerard compares to women's tongues, "which seldom cease wagging;" and Homer, to give us an idea of the activity of Penelope's maidens at the loom, says, —

> "Their busy fingers move
> Like poplar leaves when zephyr fans the grove;"

and, best of all, Walter Scott, in his lines, —

> "Oh, woman! in our hours of ease
> Uncertain, coy, and hard to please,
> And variable as the shade
> By the light quivering aspen made,
> When pain or sickness rends the brow,
> A ministering angel thou."

The foliage appears lighter than that of most other trees, from continually displaying the under surface of the leaves. The stipules are small, lanceolate, silky, transient. Fertile aments an inch to an inch and a half long, very hairy, with the crimson stigmas projecting. The sterile aments, when fully devel-



AMERICAN ASPEN. (populus tremuliformis.)

oped, are two inches in length; the deep crimson clusters of stamens distinct among the hairy scales. Fruit ripe about the 20th or 25th of May. On the sprouts which spring from the roots of this poplar, the leaves are often many times larger than those of the tree, and so differently shaped as to lead one not familiar with them to think he has found a new species. I believe the same thing is true of several other species of poplar.

The wood is soft, white, fine-grained, light, and very perishable when exposed to the weather. It is deficient in strength, and is not much used; but might serve well for floors, as it has a good color, and is not liable to splinter when bruised.

The bark is excessively bitter, with a taste precisely like quinine, to which it has an intimate resemblance in its properties.

This tree is found in Canada, as far north as 64°; and thence southward, somewhat abundantly, through the New England States, and as far as West Chester County, in Pennsylvania.

Sp. 3. The Balm of Gilead. *P. cándicans.* Aiton.

Leaf figured by Michaux, Sylva, II., Plate 98; and by Audubon, Birds, I., Plate 79.

A handsome tree, attaining sometimes the height of sixty or seventy feet; and usually, when full grown, fifty or sixty, even on the poorest soils. It grows readily and rapidly everywhere, and makes a tolerably sized tree sooner and more surely than almost any other. It has hence been planted and is still found growing, as an ornamental tree, in many situations where it is extremely difficult to make the other forest trees grow. The recent shoots are stout and large, of a deep green, with long gray dots, smooth and uniform above, ridged with strong ridges below the leaves, and striate with light green towards the base. The small trunks and branches are of a dark grayish green, of the shade called French green, with occasional

blotches of a darker color; the stalk, on old trees, rough, with long, narrow clefts, and often ridged with large, projecting ridges above the principal roots. In moist situations, yellow and red lichens and green mosses fill the cavities and invest the bark of the trunk.

The leaves are very large, on footstalks less compressed than in most poplars, and often somewhat hairy above, ovate, round, or somewhat heart-shaped at base, acuminate, obtusely and unequally hooked, serrate quite to the footstalk, somewhat three-nerved, dark green, polished and shining on the upper surface, whitish and with the veins reticulate beneath. Buds and stipules very gummy. The branches are not angled.

It throws its roots to a very great distance just beneath, and in some instances far beneath the surface. In one instance, I knew the roots to pass beneath and throw up suckers on the other side of a house forty feet wide.

This tree is desirable near habitations, on account of its agreeable fragrance in spring; but the abundant cotton of the female aments, and the appearance of the aments themselves, not unlike a large caterpillar, on the ground, constitute an objection. A more serious one is the liability of the branches, or even the trunk, when very tall, to be broken by the wind. Its particular office seems to be to act as a screen, and as a nurse to other more valuable trees while young. When this office is performed, it may be felled; but is not easily eradicated, on account of the extreme vitality of the roots, which continue for years to throw up suckers.

In favorable situations, in a moist, rich soil, this tree attains, in a comparatively short time, to a large size. I have not found this tree growing naturally in Massachusetts or elsewhere. It is, however, more frequently planted for shade and ornament than any other tree of the genus.

Sp. 4. The River Poplar. *P. lævigáta.* Aiton.

Leaves and a section of a branch figured by Michaux, under the name *P. Canadensis*, Sylva, II., Plate 95.

The river poplar is a noble tree, rising often to the height of eighty feet or more, with a fine long open head. The trunk is of a light granite-gray color, somewhat rough in old trees, with roundish ridges, separated by longitudinal furrows. The young trees and the large branches of old trees are covered with a smooth leather-like bark. The smaller branches are of a light gray; they are often dependent from the lower limbs. The upper ones go out at a sharp angle, and tend upwards. The recent, vigorous branches and shoots are of a bright green color, like the leaves, with scattered, long, white, lenticellar dots, and strongly angled by three brown, sharp ridges, running down from the the base and each side of the leafstalks. Older shoots are of a grayish green, with the ridges longer, more prominent, and of a darker color. The upper branches are conspicuously ridged, with the bark longitudinally cleft, the ridges frequently cracked across. Pith large, five-angled.

The buds are long, and taper to a long sharp point. The leafstalks are nearly as long as the leaves, and gradually and strongly compressed towards the leaf, at the base of which are often situated two or more conspicuous glands. The leaves are very broad ovate or heater-shaped, nearly as wide as long (being from three and a half to four and a half inches wide, and from four to five and a half long), right-angled, hollowed or heart-shaped at base, widening suddenly to their extreme width, and gradually but roundingly tapering to the point, which is entire, and often considerably prolonged, with a slender, sharp termination; margin undulating, and bordered by large prominent rounded serratures, each ending in a large gland turned towards the end of the leaf, and separated by

deep rounded bays; smooth and dark green on both surfaces; with white mid-rib and veins, which are irregular and much branched, and equally prominent on both surfaces.

Dr. Barratt tells me that, when in flower, the tree seems covered with aments of a light red color, becoming paler when expanded, at which time they are from three to five inches long. This tree occurs on the banks of the Connecticut, above and below Springfield, on the Chicopee at Chicopee Falls, and in various places on the Agawam or Westfield River, in situations liable to be overflowed in spring. On the Connecticut and its tributaries, it is called the river poplar.

There is a striking difference in the appearance of those branches which are vigorous, and those which are not; the former being strongly angled, the latter often not perceptibly so.

Michaux thinks this tree the same that is called cotton wood by Cass, who accompanied Lewis and Clarke to the Pacific, and by Pike in his account of the northern part of New Spain; the cotton wood of Carolina being too tender a plant to bear the intense cold of the regions in which this tree was found growing. The Mandans, 1,500 miles from the mouth of the Missouri, feed their horses, during the winter, on its young shoots.

The river poplar deserves to be introduced into cultivation as an ornamental tree. It is much the tallest and most graceful of those which grow naturally in New England. Its foliage is equal to that of the Balm of Gilead in size, and superior to it in depth of color; and the abundance of its aments in spring, and the rich colors of its leafstalks and young branches, when growing in somewhat dry situations, make it a beautiful object. By selecting cuttings from the sterile tree, the evil complained of in the cotton of the Balm of Gilead will be avoided; and the tree is of equally rapid growth, and taller and more shapely. It has been extensively introduced in England, Germany, and France, where it is valued for its

beauty and for its wood. Loudon says that the fine poplar avenues in the lower part of the garden of Versailles are of this species. In England, it is called the Canada poplar; in France, cotton wood.

Dr. Barratt, of Middletown, Conn., has very kindly communicated some very interesting and valuable observations, which he has made in reference to this poplar and others of the genus, together with some striking conclusions as to climate, which he has drawn from the times of flowering of several of the trees. I give them nearly in his own words.

The aments of *P. lævigata* are encased, during the winter and early spring, in buds with resinous scales. When the aments begin to protrude, these scales expand, nearly in opposite directions, and soon fall. This is about April 9th, and by the 18th they are in full flower. The aments are first of a rose color, and in great abundance, especially on the upper part of the tree. This monarch of the Amentaceæ then presents a noble and cheering sight, and is in a high degree ornamental. As soon as the pollen is shed, which is in two days from the time of the full expansion of the flowers, the rich red pollen cells become pale and shrivelled, and the sterile aments are soon scattered in the wind. These aments are from four to five inches long, and have from seventy to one hundred stamens resting on each turbinate scale, and of these scales or clusters of stamens, each ament has sixty or eighty. The carpels, or mature ovaries, of the fertile aments are smooth and ovate, and become ripe about the 18th of June, *just two months from the expansion of the flowers.* This fact is the more remarkable, as it is *just twice the period of the willows.* When the carpels of the poplar are fully open, the cotton adhering to the seeds is shed, and gives the appearance of finely carded cotton, profusely spread among the foliage. Hence the name *cotton tree*, and we have thus this southern material produced in Massachusetts by a forest tree.

The other poplars take nearly the same length of time to

bring their fruit to pefrection. In 1839, which was an average year, the aspen began to flower, at Middletown, April 1st; the large poplar, about the 4th; and three others, on the 9th.

Dr. Barratt has observations on the period of flowering through fifteen degrees of north latitude, which give three months as the difference in the time of beginning, or one month's difference for five degrees of latitude, which is equal to six days for one degree; so that spring goes northward at the rate of one degree in six days, or ten miles a day. This is the average for fifteen degrees, and would give a difference of five days between Middletown and Boston, the difference of latitude being 48′ 12″. The actual difference is greater, being from six to ten days, showing that the advance of spring is not uniform throughout every part of the fifteen degrees. The difference against Boston is probably owing to the influence of the chilling north-east winds which prevail at that season of the year.

Dr. Barratt's conclusion is not far different from that reached by Dr. Bigelow,[1] from a comparison of the times of flowering of several common plants, in various parts of the United States and Canada, in the spring of 1817. Dr. Bigelow made a difference of two months and a half for a difference of latitude of 13° 45′, which would be three months for 16° 30′. Generalizations of this kind, to be valuable, must be cautiously made, drawn from the average of a large number of species, and a somewhat long series of years. In the data furnished by Dr. Bigelow's correspondents, if an inference were drawn from the apple and pear alone, the difference in the season between Charlestown and Montreal, whose difference of latitude is 12° 51′, would be only one month and twenty-one days; if from the flowering of the blood-root, it would be only one month and eleven days, — conclusions widely different from those drawn from the average of all the species observed.

[1] See Memoirs of the American Academy, Vol. IV., p. 77.

Sp. 5. The Necklace Poplar. *P. monilífera.* Aiton.

Leaves figured in Michaux, Plate 96. A leafy branch is figured by Abbott, Insects, II., Plate 71, with the Kitten Moth.

This tree has an erect or slightly bending trunk, tapering gradually to a height of fifty or sixty feet, and covered with a dark granite-gray, moderately rugged bark. The branches, when the tree grows on high and rather dry land, are small, horizontal or arching upwards, with the bark more broken than on other poplars, and having a speckled appearance. The branchlets are spreading and pendulous, greenish gray, and soon roughened by transverse cracks. They are slightly angular towards the extremity. The recent shoots are very tough, greenish, or greenish gray, and very slightly angled by ridges running down from the leaves. Buds of a moderate size, shining, but with very little balsam. Leafstalk long, somewhat compressed, with the upper edge sharp or roundish, with conspicuous glands above, at the base of the leaf. Leaves broad ovate, nearly as wide as they are long, rounded or making nearly a right angle with the stalk at base, tapering rapidly to a short point, with large rounded serratures ending in a callous or glandular point, looking towards the end of the leaf; green and smooth on both surfaces, somewhat paler beneath. Pith in the small twigs very large and five-angled.

The wood is white, soft, close-grained, resilient, not disposed to splinter, and resembling apparently, in its other properties, that of the other poplars.

This is usually a slender, rather handsome tree, with a spiry, but somewhat open head.

It is found, cultivated, on the Connecticut River. In 1837, I found a large tree, growing naturally by the side of a stream in New Ashford, the leaves of which agree perfectly with those which I gathered in Middletown from trees which Dr. Barratt pronounces to be the necklace poplar.

The resemblance between the leaves, branches, and trunk of this tree and those of the river poplar is such that I should take them to be varieties of the same species. Dr. Barratt considers them as sufficiently distinguished by their fructification. In other respects I can see no marked difference, except in the smallness, and in the paleness of the under surface, of the leaves of the necklace poplar.

The tree in New Ashford of which I have spoken was supposed by the inhabitants to be a Balm of Gilead. It grows by the side of a small river, in a rich intervale, and measured, in 1838, twenty feet and five inches in circumference, at the smallest part between the ground and the branches. When first observed, fifty-five or sixty years previous, it was a small tree, not two inches in diameter. To whichever of the two species it belongs, it is a most favorable specimen of rapid growth; and it is a fine, broad-headed tree.

The necklace poplar is so called from the resemblance of the long ament of matured fruits, before opening, to the beads of a necklace. It has been cultivated for many years in Europe, where it is called Virginian poplar and Swiss poplar; the last name being given from its having been extensively propagated in Switzerland. It is also known in England by the name of Black Italian poplar, from having been introduced from Italy. It is valued for the great rapidity of its growth, which is, in the climate of London, between thirty and forty feet in seven years; and, even in Scotland, it has grown to the height of seventy feet in sixteen years; thus becoming of a size for timber, sooner than any other tree. Its timber is considered valuable in building, as, like that of the other poplars, when kept dry, it is very durable. Male trees are much to be preferred, in the vicinity of dwelling-houses, as the cotton of the seeds adheres to clothes and furniture in a most troublesome manner. — (*Loudon's Arboretum*, III., 1658, 1659.) Cuttings of this tree root more freely than those of the previous species.

There is another poplar, the true Balsam Poplar, found in

Canada, in Maine, in Vermont, and in Connecticut, north and south of us, and therefore probably also in Massachusetts, which I have not detected growing naturally in any part of the State. It has a great resemblance to the Balm of Gilead, differing from it in having smaller leaves, which are uniformly rounded at base, and never heart-shaped. In the upper part of the town of Kennebunk Port, in York County, Maine, in a sheltered hollow of three or four acres, by the side of the Kennebunk River, on the land of George Thompson, I found this tree growing naturally in large numbers. Thence it has been extensively propagated to the neighboring towns. On the leaves of the trees there, I observed the caterpillar of the kitten moth, *Phalœna furcula*, which Abbott has represented as living on the leaves of a kindred species, the necklace poplar, in Georgia.

VIII. 2. THE WILLOW. *SALIX.* L.

The willows are more difficult to identify than any other trees. Anderton, in "Prodromus," XVI., p. 191 to 323, enumerates one hundred and sixty. Hooker and Arnott describe, in "British Flora" for 1855, thirty-eight as belonging to Britain. Dr. Gray, in his "Manual," describes twenty-two as belonging to the Northern United States.

The willows are distinguished from the poplars by having the scales which form the aments entire, and by having only from one to seven stamens in the sterile flowers. The fertile contain a single ovary, surmounted by two stigmas, which are usually two-parted. The willows are shrubs or trees, varying in height from two or three inches to eighty or ninety feet. They are natives of the cooler regions of the northern hemisphere, of both continents, — in all of Europe, and half of Asia; some of them being smaller, and extending farther north, than any other woody plants except birches, and others being found in mountainous regions in Africa, India, China, and Japan.

Growing naturally on plains, in moist situations by water-courses, they are often lofty trees; on mountains and dry plains, they are in all of North America and part of South America, for the most part, diminutive shrubs.

The roots of the willows are remarkable for their toughness, magnitude, length, and tenacity of life. On the borders of streams, they often form masses which present a powerful resistance to the action of water; and they are not unfrequently many times larger and longer than the stems which issue from them. The stems are upright or spreading; the branches round, slender, and very flexible; the bark rather tough; the leaves simple, and usually of much greater length than breadth, and accompanied, on opening, by two stipules, which are often permanent and remarkably large, but often caducous; the buds are covered with a leathery, concave scale. The aments are terminal or lateral, and appear, in different species, before, with, or after, the leaves. The willows are like the poplars in the rapidity of their growth, and in the facility with which they may be propagated by offsets, layers, and cuttings.

"The many important uses," says Hooker, "rendered to man by the different species of willow and osier, serve to rank them among the first in our list of economical plants." In the extreme north-western regions of Europe, the inner bark is kiln-dried and ground, to be mixed with oatmeal in times of scarcity; and, in the same countries at present, as in many countries at an early period of civilization, the twigs and branches have been of important use in constructing household utensils, panniers, harness, apparatus for fishing, and even habitations. The tough bark may be used for cords and matting; and, in Tartary, its fibres have been spun and woven into cloth. Dr. Walker, a writer upon the willows, relates that "he has ridden in the Hebrides with a bridle made of twisted willow twigs, and lain all night at anchor with a cable made of the same material." — *Loudon*, 1450.

The bark of most species of willow, especially when stripped from the younger branches, is remarkable for its bitterness and astringency; and has been long employed, with marked success, in the treatment of intermittent fevers, and in other cases which require the use of tonics. It is the best substitute known for Peruvian bark. In like manner, the salicine already spoken of, in the form of a sulphate, may take the place of sulphate of quinine, and is said to be preferable in the case of patients of a delicate and irritable temperament.[1]

The wood of the willow is soft, smooth, light, elastic, pliant, and tough. In Europe, in ancient and modern times, it has been applied to many uses for which, in this country, other woods are commonly preferred. The larger trees take the place of pine, and are sawn into boards and planks for the framework and flooring of buildings; and, when kept dry, are found to last, without decay, for more than a century. In Scotland, small vessels are made of the wood. It is also in request for the use of the turner, and for lasts and toys; as a substitute, when dyed, for ebony; also for ladders, for implements of husbandry, for the lining of carts, and especially for use in works exposed constantly to water. The branches and twigs are of the first value for all kinds of wicker-work and basket making, for hoops, and for all the purposes for which toughness, pliancy, and elasticity are required. The wood is also extensively used, in many parts of Europe, for fuel; making a pleasant, clear fire, with little smoke. The best sorts for timber are the white, the Bedford, the crack-willow, and the goats' willow; the three first of which have been introduced into this country, and are often seen growing here.

The leaves of the willows are devoured by the large black caterpillars of the Antiopa butterfly (*Vanessa Antiopa*, Harris's Report, p. 296), and the branches are sometimes completely stripped. The caterpillar of the fork-tail moth (*Cerura*

[1] *Elémens d'Histoire Naturelle Médicale,* Par M. Achille Richard, 3me ed., 1838. Tom. III., 185.

borealis, ib. 223) is also found on their leaves. A species of plant-lice, called by Dr. Harris the plant-louse of willow groves (*Aphis Salicti*, ib. 239), is found clustered together in great numbers on the under side of the branches of various kinds of willow, and drawing their subsistence from the plant on which they live. The grubs of the horn-bug (*Lucanus Capreolus*, ib. 44) live in the trunks and roots of old willows, as well as in those of apple trees and oaks.

The male and female trees of the various species of willow, are found to differ in their luxuriance and growth, and somewhat in the quality of the wood. The female is thought to grow with more vigor, and to produce larger stems; the male to have equal toughness, but to be more slender and delicate. The usual properties of our native willows will be mentioned, when known, in the description of the several species.

The willows present greater and more numerous difficulties to the student than any other family of plants. These have been enumerated by one of the greatest of modern botanists (De Candolle, *Flore Francaise*, III., 282) as follows: 1. The species are often trees which can be but imperfectly judged of from figures or specimens; 2. The male and female are distinct plants, so that the knowledge of an individual does not complete that of the species; 3. The flowers often expand at a different time from the leaves; 4. The leaves present little variety and few marks of distinction; 5. The seeds are usually unproductive, so that we are prevented from rearing doubtful species for study; 6. Most of them grow readily from cuttings, — a frequent and most fertile cause of varieties; 7, and, lastly, garden cultivation entirely changes their appearance.

For these reasons and others, there is little certainty in regard to several of the species; and in regard to many of the native sorts, I have not had opportunities of making sufficiently accurate and continued observations to authorize me to speak with confidence. Professor De Caisne, of the Museum and Jardin des Plantes of Paris, thinks that many of the willows —

SAGE WILLOW (Salix tristris.)

it is impossible to say how many — are hybrids. They so run into each other that no two botanists agree as to what should be considered species and what varieties. Dr. Gray, with the nicest and most discriminating eye, differs very often, in regard to our willows, from Barrett, who made a special study of the willows. In the first edition I followed Barrett ; in this, I take as my guide Dr. Gray, who has had more experience in the designation of plants than any other botanist, and has been assisted by the able John Carey, Esq.

From the rapid destruction of our native forests, the willows may come in, as a valuable substitute for other woods, as the very great rapidity of their growth recommends several of those introduced ; the white, the black willow, the Bedford, and the yellow willow, or golden osier, for cultivation as timber trees, as several of them will produce stems large and long enough for many important uses, in a shorter time than any of our native trees.

Some of the willows are very beautiful trees, with remarkably rich foliage, every leaf delicate and finely colored a soft silken or silvery green. For their uses and for their beauty, the willows richly deserve study, — the very difficulties of which should be an incentive. Every botanist, who can, should carefully study the flowers of one or more species, the few days they continue in blossom, and their leaves also.

Sp. 1. The Sage Willow. Dwarf Gray Willow. *Salix tristis.* Aiton.

Leaves almost sessile, wedge-lanceolate, pointed, or the lower obtuse, grayish-woolly on both sides, the upper side becoming nearly smooth at maturity: stipules minute, hairy, very early deciduous; catkins globular when young, loosely flowered; ovary with a long tapering beak, clothed with silvery hairs; style short; stigmas two-lobed. Shrub one to one and a half feet high, much branched; leaves thick, one and a half inches long. Stipules seldom seen, often reduced to a mere gland. A variety occurs with very small and rigid contorted leaves.

Found on dry, sandy plains, the smaller variety conspicuously grayish and sage-like in its appearance, and from one to three

feet high; the larger, three or four feet high, with larger, broader, and longer leaves of a deeper green.

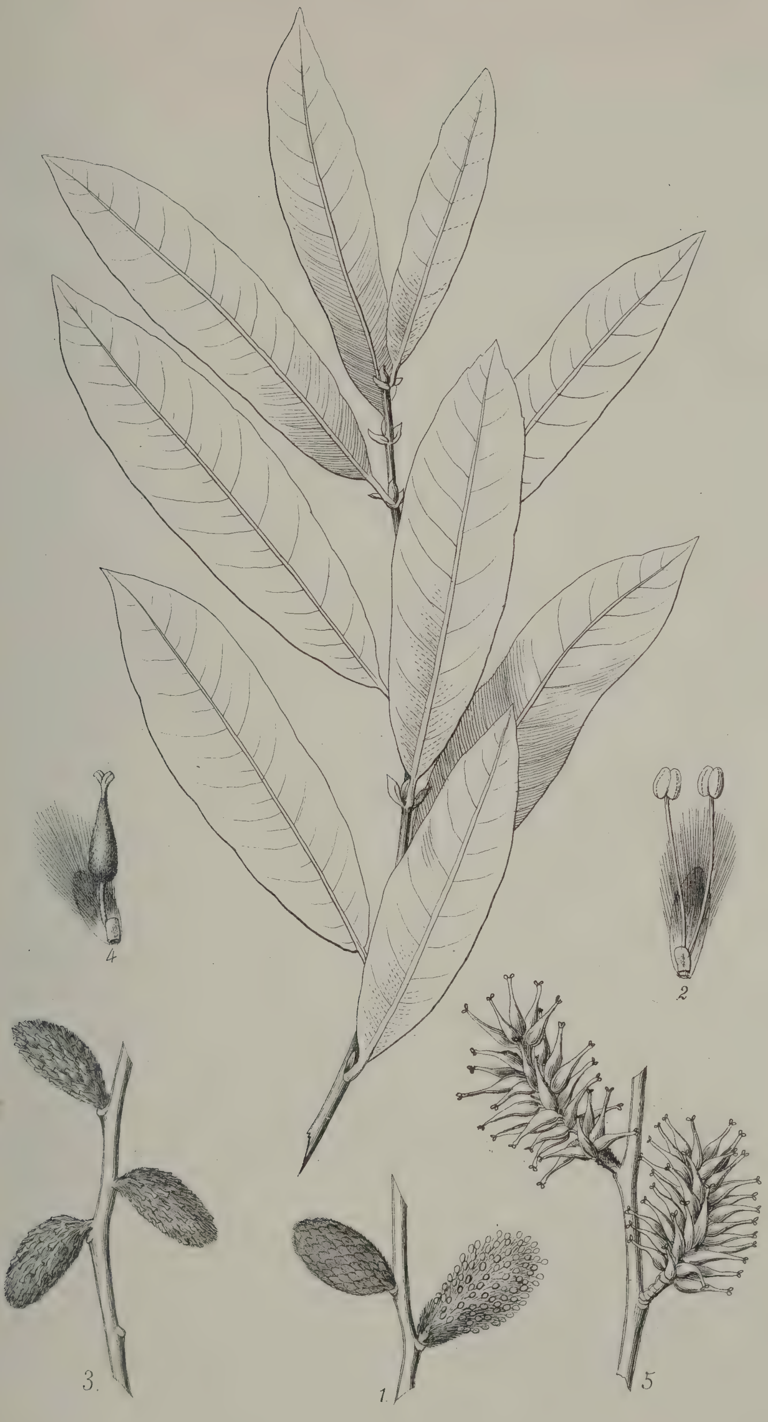
The sage willow is a slender, hoary plant, or a spreading tufted bush, one or two feet high, growing in the openings and on the borders of dry, sandy woods. Its root is large and strong, often an inch or two in diameter, with reddish wood and thick bark, extending some distance, often two or three feet, at a few inches beneath the surface. From this rise several stems of a yellowish green, or, later, grayish brown, somewhat downy, and clouded often with dark brown. The central stem, long and very slender, bears the fructification. After the decay of which, it is bare, or with a few leaves at the extremity. From the lower part of it, and from the other stems, shoot the leaf-bearing branches. On these the leaves are somewhat crowded, narrow-obovate, spatulate, one or two inches long, broadest towards the upper end, and tapering gradually to a very short petiole, acute at the extremity, reflexed and waved at the margin, downy on the mid-rib and veins, and corrugate, sage-like above, whitish tomentose beneath. It not unfrequently bears small leafy cones.

In one sub-variety, the leaves are crowded and very short, not half an inch long, and the whole upper part of the plant is covered with a dense, whitish gray tomentum.

Sp. 2. Low Bush Willow. *S. hùmilis.* Marshall.

Leaves petioled, lanceolate or obovate-lanceolate, acute or obtuse with an abrupt point, slightly downy above, more thickly so, or sometimes grayish-woolly, beneath; stipules small, semi-ovate and entire, or larger and lunar with two to four teeth, shorter than the petioles; catkins often recurved; ovary hairy; style distinct; stigmas two-cleft.

The main stem is smooth and of a bright green below, clouded and somewhat downy above. The recent branches greenish yellow, downy, and spreading. Leaves from one and a half to three inches long, oblong lanceolate, half an inch



BUSH WILLOW (*Salix humilis.*)

wide, pointed at the extremity, rounded or rather acute at base, entire, waved, revolute at the margin, corrugate with depressed veins, and sage-like, with the mid-rib downy above, glaucous, with the mid-rib and veins prominent beneath, but without down on the mature leaves. The young leaves are downy on both surfaces, — revolute in æstivation; stipules small, ear-shaped, pointed above, with one or two teeth on each side, recurved at the margin, sometimes appendaged at base.

Similar to these and resembling them in the naked, persistent, virgate stems which had borne the fructification in the preceding spring, is a willow intermediate between these and *S. rostràta*, perhaps a variety of the latter, with broad, oblong, lanceolate leaves, waved or crenate at the margin, and revolute, smooth, but corrugated and sage-like above, very downy beneath, pointed, often acuminate, at the end, rounded at base, on a short petiole. I take this to be *S. recurvàta* of Pursh.

It is a shrub six or eight feet high, with light brown bark on the trunk, dark brown above, with a dark, clouded pubescence on last year's shoots. The recent shoots are pale green and somewhat pubescent.

Leaves on short petioles, lanceolate or oblanceolate, usually broader towards the extremities, rather acute at each end, nearly entire, with a light, silky pubescence above when young, afterwards smooth and shining, but strongly marked with depressions at the veins and nerves; rugose and veiny beneath; revolute and waved on the margin; vernation revolute. Stipules about as long as the petiole, unequally ovate, pointed, sometimes entire, often with one or two teeth on each side, downy.

Aments appearing before the leaves and on distinct branches; the staminate half an inch long, often recurved, with two or three small leaves at base; scales rounded, brown, with thin, long, silken hairs, particularly on the edges; stamens two, on

long filaments; pistillate, one third to one half an inch, recurved; scales dark brown, somewhat silky; germens ovate, closely covered with whitish, silky pubescence, supported on long pedicels, and tapering gradually to the bifid stigma.

Sp. 3. The Two Colored Willow. Bog Willow. Glaucous Willow. *S. díscolor.* Muhlenberg.

Leaf figured in Annals of Botany, II., Plate 5, fig. 1.

Leaves lanceolate or ovate-lanceolate, acute, irregularly toothed on the sides, entire at the base and apex; stipules semilunar, toothed; catkins erect; scales very hairy, oblanceolate, somewhat acute; ovary densely silky. (S. sensitìva, *Barratt?*) — Low meadows and river-banks; common. — A large shrub or small tree, eight to fifteen feet high. The young leaves are commonly obtuse and pubescent, at length becoming smooth and whitish glaucous beneath. Stipules in the vigorous shoots equalling the petiole, more often small and inconspicuous. Young catkins one and a half inches long, glossy, blackish with the conspicuous scales, elongating in fruit to two and a half inches.

I have many specimens of leaves and flowers, which Dr. Barratt pronounces to belong to this willow. They do not, however, agree with the description of Pursh or the better description of Willdenow. The leaves are twice or thrice as long as those described by Willdenow and figured in the "Annals of Botany."

There are great defects in the descriptions given of our willows, by most foreign botanists. Not unfrequently, their descriptions will apply equally well to several plants, and specimens may be gathered from the same plant more unlike than the descriptions of so-called distinct species. Dr. Bigelow found this willow in wet swamps at Dedham.

Sp. 4. The Silky-headed Swamp Willow. *S. eriocéphala,* Michaux. *Prinoìdes,* Pursh. *Crássa,* Barratt.

Leaves oblong-oval, acute, rounded or tapering at base, sparingly and irregularly toothed; stipules semilunar, toothed; catkins densely flowered, thickly covered with long shining hairs; scales of the sterile ones round-

Salix discolor SILKY HEADED WILLOW. *S. eriocephala*

obovate, obtuse; ovary conspicuously stalked, downy. Low meadows and swamps. Closely resembles the last; but the aments are more compact and silky, and the scales rounder.

A small tree, conspicuous in the swamps in April for its large and very densely woolly or silky catkins.

Of the variety called *prinoìdes*, the matured and flowering branches are smooth, shining, dark purple: the recent leafy twigs, very slightly downy, and brownish at first, but soon turning dark and smooth. The leaves are oval-oblong or elliptic-lanceolate, entire and wedge-shaped, remotely waved-serrate, sometimes distinctly serrate, on the edge, ending in an acute or prolonged point, mostly entire. Young leaves silky-downy; mature, smooth on both surfaces; mid-rib sometimes downy above; glaucous beneath; of a thin and delicate texture. Stipules half-heart-shaped, or ear-shaped; sometimes small and nearly entire, sometimes half an inch long, and more or less sharply toothed.

Female ament cylindrical, one or two inches long, somewhat crowded, on a short stalk invested with a few cucullate, silky-downy, whitish, transformed leaves; scales oblong, hairy, purple; ovaries on a rather long stalk, ovate, silky, tapering to a long style, with the stigmas somewhat deeply cleft. Male ament an inch or more long; filaments long.

Of the variety called *crássa* by Barrett, he says: "A small tree about fifteen feet high; bark on the stem rough and ash-colored; branches irregular and knotty; twigs thick, and densely flowered. The ends of the young branches protected by a soft pubescence.

"This is a very hardy species, and one of the handsomest early willows we possess, and highly ornamental in plantations. A few sunny days in spring will cause its rich yellowish white catkins to expand or open. It is so admirably adapted to withstand cold by its dense soft hairs, that the frosts of spring retard, but do not injure or kill, its expanded catkins. The clothing or wool of the aments is not sensibly changed in

color by the solar ray. This species is rather rare with us, and may possibly be found more plentifully in higher northern latitudes. It seems, indeed, to possess all the fitting requisites for enduring a severe climate; and affords a beautiful exemplification of nature's economy, in the structure of the catkins of the willow, providing those exposed during flowering time to severe cold, with a vesture which outvies the imperial ermine." — *Barratt.*

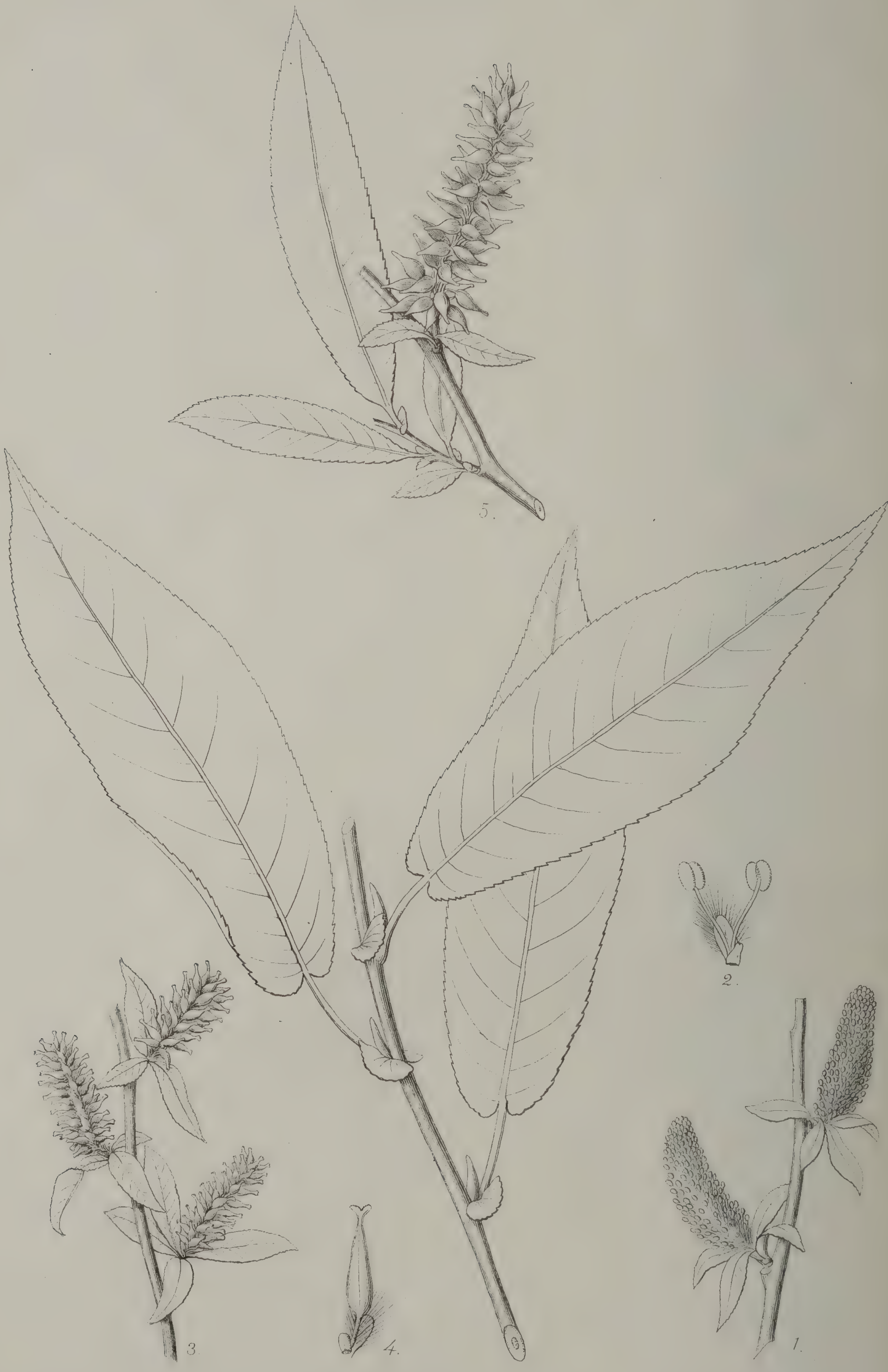
An attentive observance of this and some other willows, has satisfied me, that the hairs or clothing of the scales of the catkins, besides protecting them from frost, perform, in this and other groups, a function similar to the scales of the ament; and the scales are manifestly only modified leaves. Both of the plants are found abundantly at Brookline and elsewhere, and answer to the descriptions which Dr. Barratt has given. I have, however, always considered these two and the two preceding as varieties of one willow, with some striking differences certainly, but not greater than are found in what are universally admitted to be varieties of the apple, the pear, and the plum trees.

Sp. 5. The Silky Leaved Willow. *S. serìcea.* Marshall.

Leaves lanceolate, pointed, downy above, grayish underneath with short silky hairs; sterile catkins small; the fertile narrowly cylindrical, closely flowered; scales obtuse, round-obovate, as long as the stalk of the densely-silky ovoid ovary; stigma two-lobed, nearly sessile. (S. grìsea, *Willd.*) Sandy river-banks; not rare. Shrub four to ten feet high. Fertile catkins in flower three-quarters, at length one and one-quarter, of an inch long; the ovaries not spreading or elongating in fruit, thus appearing sessile.

The variety called *grìsea* is a shrub usually five or six feet high, sometimes a small tree twelve or fifteen feet high, growing in or near places wet or inundated the greater part of the year, usually much branched and abundantly set with leaves. The female aments are very numerous, coming out just before

SILKY LEAVED WILLOW. (*Salix sericea.*)



HEART-LEAVED WILLOW. (*Salix cordata.*)

the leaves, half an inch long, erect, on a short footstalk, which is invested with two or three linear leaves, of nearly the same length as the aments. Ovaries gradually tapering or ovoid, on a very short stalk, crowded. Smaller branches reddish green, or greenish, at last olive, tough, but very brittle near the base. Older ones ashy gray. Male aments three fourths of an inch long, with broader leaves on the footstalk, very silky. Leaves half an inch by three inches or more, lanceolate or narrow-elliptic, sometimes a little falcate. Stalk rather long, silky above, rounded or rarely acute at base, tapering to a long point, serrate, the serratures glandular and bent towards the point of the leaf, sometimes undulate, smooth, often shining, with the mid-rib downy above ; glaucous, silken, or hairy, sometimes smooth, beneath. Stipules half-heart-shaped, ending in an acute or blunt point above, serrate. The leaves on the branches near the trunk, smaller, more acute, and silky.

Its twigs are long and slender and very tough, yet extremely brittle for an inch or two at base, so as to break short with little resistance. The leaves blacken in drying, and communicate a deep permanent stain to the paper in which they are dried or afterwards kept. It promises to be useful to the basket-maker, and probably contains, in its extremely bitter bark, a valuable dye, as it certainly does a great quantity of some bitter principle.

Sp. 6. The Heart-leaved Willow. *S. cordàta.* Muhl.

Leaf figured in Annals of Botany, II., Plate V., fig. 3.

Leaves lanceolate or ovate-lanceolate, truncate or heart-shaped at base, taper-pointed, sharply toothed, smooth, paler beneath; stipules kidney-shaped or ovate, toothed, often large and conspicuous, of the length of the (when young downy) petiole, or sometimes small and almost entire; catkins appearing with the leaves, leafy at base, cylindrical, the fertile elongating in fruit; ovary lanceolate, tapering to the summit. — Var. ríɢɪᴅᴀ has the leaves large and rigid, with coarser teeth, of which the lowest are somewhat elongated. (S. rígida, *Muhl.* S. Torreyàna, *Barratt*, which has leaves of a deeper green beneath, appears to belong here.) —

Var. MYRÌCOIDES has narrower leaves, neither heart-shaped nor truncate at the base. (S. myricoìdes, *Muhl.*) — Inundated banks of rivers and low meadows ; common. — Shrub two to six feet high : the first var. larger, or a small tree six to fifteen feet high, with leaves four to six inches long. Fruiting catkins two to three inches in length.

This is a beautiful low tree, varying from eight or ten to twelve or fifteen, and even twenty or more, feet in height. Stem brown, or, on older stalks, ashy-gray or clay-colored. Branches greenish brown, or bright green, or bronze yellow, smooth ; recent shoots varying, on the same stem, from bright to faint yellow, dusty or downy white, and apple-green. Buds yellow, tipped with reddish, downy. Leaves usually somewhat crowded, and then very cordate at base, at other times scattered, and rounded at base ; folded back, in the bud, covered with silky pubesence when young, smooth above, glaucous beneath when mature ; flat, waving, or recurved, ovate-lanceolate or broad-lanceolate, tapering to a somewhat long point. Male aments an inch long ; female, one and a half inches.

This willow is found on the streams of Canada as far as the Saskatchawan. It abounds on the Connecticut, Nashua, and other rivers of this State, and is found in New York, and as far south as Virginia, presenting some remarkable varieties. The roots form large, tangled masses, on the sides of streams, and are much larger than the stems proceeding from them. Dr. Barratt says it furnishes excellent twigs for basket-work.

The variety *rígida* is a more vigorous or coarser looking plant than the last ; resembling it very much, but distinguished by the length of its hairy petioles, the coarseness of the serration of the leaves, and the prolongation and stiffness of the lower serratures.

It is a handsome small tree, sometimes fifteen feet high. The stem is grayish, rather smooth, erect and slender, or prostrate along the banks of streams, where its large roots, with those of *S. cordàta*, *S. lùcila*, and *S. nìgra*, form dense and strong bulwarks against the action of the stream. The

branches are grayish green, or gray: the recent shoots, a bronze yellow, often clouded, brownish and downy; often bright red where exposed to much light. The lower serratures of the leaves are enlarged, prolonged, and rigid.

It is found between Fort Franklin and Cumberland House, in British America, and in Pennsylvania. In this State, I have found it on the Hoosic, abundantly on the Connecticut, about the pond in Westminster from whence flows the Nashua, and along the banks of that river.

"This strong and handsome species furnishes excellent twigs and rods for the heaviest kinds of basket-work. This willow and *S. cordàta* are very ornamental in groves and plantations. There are several varieties of *S. rígida*, and of the aments I have met with great diversity. The largest of these catkins are one and a half to two inches long, and when the flowering season is fine, and the catkins have escaped being drenched with rain, I have found these flowers of great beauty, exhibiting a play of colors from violet or purple to yellow; as the stamens rise over the tips of the scales from their downy bed, they yield the resplendent colors of the rainbow, and this zone is carried symmetrically onward, by the successive elongation of the filaments." — *Barratt.*

Of the variety Torreyàna Dr. Barratt says: —

"This ornamental willow seldom exceeds eight or ten feet in height; and will be readily recognized in autumn from the other willows of this fine group, by its broad, heart-shaped, glossy, deep-green leaves, wavy margin, and sharp point; also by its large stipules. The leaves do not blacken in drying; it is very distinct from *S. rígida* and *S. cordàta*. This is probably one of the best native willows we possess, for protecting the banks of rivers with rapid currents. It does not grow as high, and is more disposed to spread in these situations than its congeners, *S. cordàta* and *S. rígida*. It furnishes abundance of stout twigs or rods."

I found this beautiful willow growing abundantly along the

banks of the Connecticut, in Longmeadow and Springfield, and also on the plains between the Arsenal and Chicopee Falls. As found growing on the uplands, it is a showy plant, six or eight feet high, stem erect or bending, of a light gray color, with blackish clouds, Branches long, bending upwards, of a shining gray. Twigs bronzed or yellowish green, with a red or purplish hue above. Stipules very large, half-heart-shaped, rounded above, often folded around the leaf so as to appear double. Leaves rich and luxuriant, hearted or rounded at base, broad, oblong-lanceolate, tapering gradually to a long point; footstalks short.

Sp. 7. The Beaked Willow. *S. rostràta* Richardson.

Leaves oblong or obovate-lanceolate, acute, obscurely toothed, downy above, prominently veined, softly hairy and glaucous beneath; stipules semilunar, toothed; catkins cylindrical, the fertile becoming loose in fruit; pods tapering into a long beak, on stalks longer than the yellow lanceolate scales. Borders of woods and meadows, New England to Pennsylvania, Wisconsin, and northward. A shrub or small tree, four to fifteen feet high, with soft velvety leaves, somewhat variable in form. A transformation of the anthers into imperfect ovaries is frequently observable in this species, and occasionally in some others.

This is a distinct and well characterized willow, found growing in every variety of soil, more frequently in dry, but flourishing best in one moderately rich and moist, in open woods, or by the sides of forests. It is a shrub or small tree, from three or four to ten or twelve, or even fifteen, feet high.

The stem is reddish or olive-green, or gray, striated, with an orange-grayish, or clay-colored epidermis. The shoots are downy, of a reddish purple, or yellowish, or reddish above, where exposed to the sun, and green beneath. In drying, they turn to a brown or dark purple. The leaves are on short, downy footstalks; obovate, oblong-elliptical, or broad lanceolate, often inequilateral, rounded or tapering at base, acuminate on the ends of the branches and recent shoots, with the acumination turned half round; near the stem,

(Salix livida) BEAKED WILLOW (Salix rostrata.)

shorter and broader, pointed, or obtuse; downy, or smooth, but with the surface always conspicuously netted with depressed veins above, and white-downy beneath. Margin entire or waved, crenulate or serrate, the serratures ending in a black point. The stipules are ear-shaped, often nearly entire, sometimes cleft to the base, sometimes toothed, and pointed above and below, or serrate. The leaves, when young are downy on both surfaces.

Sp. 8. The White Willow. *S. alba.* L. *Introduced.*

Figured in Sowerby's English Botany, 2430. The tree in Loudon, Arb., VII., 209.

Leaves lanceolate or elliptic-lanceolate, pointed, toothed, clothed more or less with white and silky hairs, especially beneath; stipules lanceolate; stigmas nearly sessile, thick and recurved. Var. VITELLÌNA has yellow or light red branches: leaves shorter and broader. (S. vitellìna, *Smith & Borrer.* S. Pameachiàna, *Barratt.*) Var. CÆRÙLEA has the leaves nearly smooth at maturity, and greatly resembles the next species. (S. cærùlea, *Smith*). A familiar tree, of rapid growth, attaining a height of fifty to eighty feet.

"A native of Europe, from Norway and Sweden to the Mediterranean Sea; of the north-east and west of Asia; near all the large rivers of Russia and Livonia, especially the Irtish, where it attains the height of a large tree." — *Loudon*, 1523. It has long been more extensively planted throughout Britain, as a timber tree, than any other species. It grows rapidly, often to the height of thirty feet in ten years, and, in favorable situations, attains an elevation of even eighty feet and upwards. It has been extensively planted in various parts of the Continent of Europe, particularly in Russia, on the road from Moscow to the Austrian frontier.

It has also been introduced and extensively planted in this country; and it is the commonest of those long ago introduced.

The Yellow Willow, or Golden Osier (*S. vitellìna*, L.), also introduced, which Dr. Gray regards as a variety of *alba*, —

figured in Sowerby's English Botany, 1389; the tree in Loudon, Arb., VII., Plate 206, — is a native of Britain and various other parts of Europe, where it is extensively cultivated as an ornamental tree, and as an osier, and grows sometimes to the height of fifty or sixty feet.

The golden osier has been more extensively propagated in New England than any other foreign willow, except the white. It is found in many parts of Maine, where it sometimes attains a height of thirty feet; in New Hampshire, Vermont, Connecticut, and all parts of Massachusetts. As it grows here, the trunk is rarely erect, but inclining to one side, with a darkish bark, furrowed, on old trees, with pretty deep furrows. The branches are very spreading, of a whitish green, with long dark cracks. The smaller branches are of a greenish yellow, and smooth. The terminal shoots are long, slender, dependent, of a bright yellow color. The leaves are long, lanceolate, finely serrate, tapering at both extremities, of a polished green above when mature, whitish-glaucous beneath, more or less covered with silky hairs when young. The footstalk is short, often with a dark gland at the base of the leaf on each side.

Sp. 9. The Crack Willow. *S. frágilis.* L. *Introduced.*

Figured in Sowerby's English Botany, Plate 1807, and in Loudon, VII., Plate 205.

Leaves lanceolate, taper-pointed, smooth, glaucous beneath (slightly silky when young), serrate with inflexed teeth: stipules half-heart-shaped; stamens commonly two. Var. DECÍPIENS has dark brown buds, and the lowest leaves on the branches broadly obovate, very obtuse. S. decípiens, *Hoffm.*) Var. RUSSELLIÀNA has the leaves long and bright, strongly serrate; the younger ones, and upper branches of the annual shoots, silky-downy towards autumn; stipules large and taper-pointed. (S. Russelliàna, *Smith*). A tall and handsome tree, with smooth polished branches; cultivated for basket-work.

"A tall, bushy-headed tree, sometimes found from eighty to ninety feet in height, with the branches set on obliquely,

somewhat crossing each other, not continued in a straight line outwards from the trunk, by which character it may readily be distinguished in winter." — *Sir J. E. Smith.* The branches are round, and "so brittle at the base, in spring, that with the slightest blow they start from the trunk." Hence is derived its name; and from this fact Sir J. E. Smith infers that the wood cannot have the valuable properties which have been attributed to it, they belonging, of right, to the Bedford willow.

If this is the only ground of his decision, it is a rash one, since most of the willows in this country which are remarkable for toughness, are also remarkable for breaking easily at the base of the branches, in spring; and, indeed, at other seasons. The long branches which form the head of this fine tree should have shown that they must have considerable strength to resist the force of the wind at such a height. And a practical man, Mr. Mathew, gives a very different opinion. "The red-wood willow, or stag's-head osier (*S. frágilis*), produces timber superior to that of any other tree willow. It is much used in Scotland for building small vessels; and especially for fast-sailing sloops of war, by reason of its lightness, pliancy, elasticity, and toughness. The wood, when dry, is easily known from that of all other willows, by its being of a salmon color; on which account it is sometimes used in cabinet-making, and for children's toys." — Loudon, *Arb.*, 1460.

This willow, a native of Britain, has been introduced and somewhat extensively propagated in this vicinity. Some of the largest willows near Boston, particularly those on Willow Street, in Dorchester, are of this species. I find some of the leaves at the base of the aments, and on the accompanying branchlets, perfectly entire. This seems, also, to be the case with those figured in English Botany, 1807.

"This forms a small tree of handsome growth, flowering in May. It is readily known by the very smooth bark of the last year's shoots, which is of a light reddish brown, or clay

color, appearing as if varnished. The young twigs are often beautifully stained with crimson. Leaves very much akin to those of the Bedford willow, but mostly smaller." — Smith, in *English Botany*, 1937.

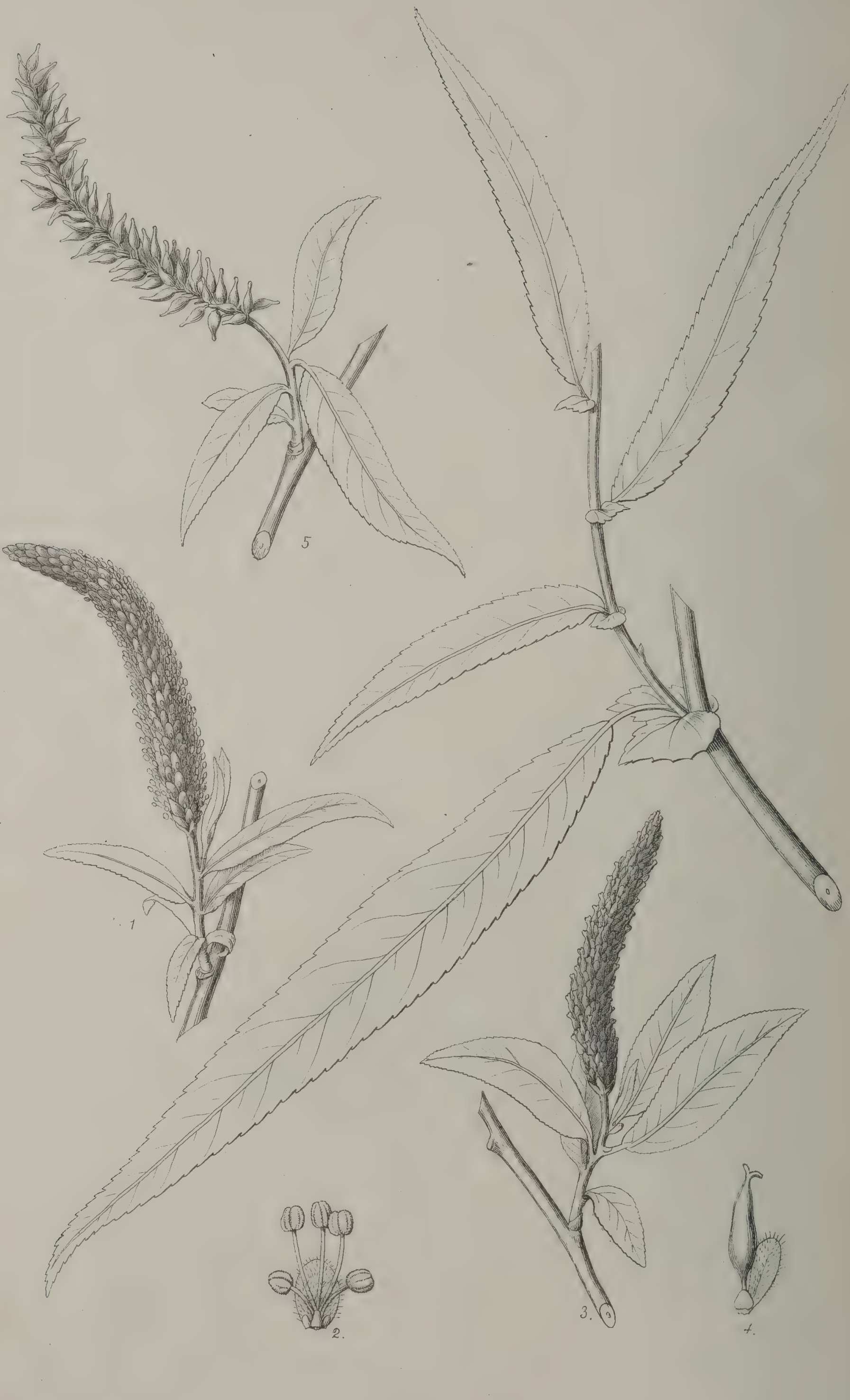
The varnished or porcelain appearance of the branches, which gives it its name of Varnished Willow, not conspicuous at other seasons, makes this willow easy to be distinguished in winter and early spring. It has been extensively propagated in the neighborhood of Boston, and may be seen on the turnpike road to Salem; and in West Cambridge, in several places on the road to Lexington.

This species is a native of Britain, and has been much cultivated in England for basket work. For a few years, in moist ground, it annually produces rods six or eight feet long; but these gradually become shorter, and the plant ceases to be worth cultivating.

The variety called the Bedford Willow (*S. Russelliàna*, Smith; introduced,— so named in honor of the Duke of Bedford, who first brought it into notice) is figured in Sowerby's English Botany, 1807, and Loudon, III., 1518.

This tree, a native of Britain, attains sometimes to as great a height as the crack willow, and is considered far more valuable. It is remarkable for the rapidity of its growth in its natural soil, and it grows with more vigor in the neighborhood of Boston than any other willow, native or foreign. The favorite tree of Dr. Johnson, at Litchfield, which was destroyed a few years ago by a hurricane, was of this species.[1] It is extensively cultivated in England for poles, for its wood, and for its bark, which has been ascertained to contain more of the tannin principle than the oak. Mr. Lowe, in his survey of

[1] A few years before the Doctor's death, this tree measured fifteen feet nine inches in circumference at the ground, and eleven feet ten inches at the smallest place below the branches. It continued to increase till 1810, when it measured twenty-one feet in girth at six feet from the ground. In 1829, it was blown down. Loudon has given a figure of this tree as it appeared at the time of Dr. Johnson's death, and also just before its destruction. See *Arboretum*, III., pp. 1520, 1521.



BLACK WILLOW. (*Salix nigra.*)

Nottinghamshire, says that a plantation of it, of eight years' growth, yielded a net profit of 214*l.* per acre. It flowers in April or May.

This tree may be known from the others of this group by the length and brightness of the leaves, their large serratures, and their occasionally leafy footstalks, and by the length and straightness of its vigorous green shoots.

Sp. 10. The Black Willow. *S. nigra.* Marshall.

Leaves figured in Michaux, Sylva, III., Plate 125, fig. 1, and in Annals of Botany, II, Plate 5, fig. 5.

Leaves narrowly lanceolate, pointed and tapering at each end, serrate, smooth (except on the petioles and mid-rib) and green on both sides ; stipules small, deciduous ; glands of the sterile flowers two, large and deeply two to three cleft ; stamens four to six, often but three in the upper scales. (S. ambigua, *Pursh.*) — Var. FALCÀTA has the leaves elongated, scythe-shaped, and the stipules large, broadly lunar, reflexed. (S. falcata, *Pursh.* S. Purshiàna, *Spreng.* S. ligustrìna, *Michx. f.*) — Tree fifteen to twenty-five feet high, with a rough black bark; frequent on the margins of streams, especially southward.

A small tree, eight or ten feet high, growing usually on the edge of streams and lakes, and bending over the water. The twigs are light green, downy, rendered slightly angular by the continuance downwards of the vessels of the leafstalk. Leaves lanceolate, very downy and acute when young, afterwards lengthening much, tapering to a long point, and becoming smooth, often somewhat falcate, serrate, the serratures glandular, green on both surfaces, finally smooth, except the mid-rib above, and sometimes below. Footstalks short, hairy, sometimes with ferruginous glands near the base of the leaf.

Flowers in May; capsules ripe in June. This willow becomes larger, further south. Darlington says it is, in Chester County, Pennsylvania, fifteen to twenty feet high, with a diameter of from eight to fifteen inches, and a dark-colored, rough bark, with a stem often crooked or leaning.

Dr. Barratt says that, at Middletown, Connecticut, "It is known to basket-makers as the 'wicker willow,' and is much esteemed for its great elasticity, in fine kinds of wicker-work. It approaches the nearest of any of the native willows to *S. triandra*, of Europe. This is the last of the willows to flower. The capsules ripen in about a calendar month; and this, as a general rule, will apply to the rest of the willows, varying but little in ordinary seasons. Flowers May 18th; capsules ripe June 18th." — *Salices Am.*

Michaux says this is the most common of American willows, that it is multiplied particularly in the Middle and Western States, and is found along the banks of the large rivers. He found it sometimes thirty or thirty-five feet high and twelve or fifteen inches in diameter. "Upon the trunk the bark is grayish, and finely chapt; upon the roots it is of a dark brown, whence may have been derived the specific name of the tree. The roots afford an intensely bitter decoction, which is considered in the country a purifier of the blood, and a preventive and remedy for intermittent fevers." [1]

The variety called Pursh's willow is a slender tree, growing on the banks of streams and lakes, in situations sometimes overflown, conspicuous for its remarkably soft and delicate foliage and graceful head. It sometimes attains to the height of forty feet, from a base of but four or five inches in diameter. It is often much larger. On the banks of the Nashua River, in Lancaster, I measured many stems a foot in diameter, and one which, at the height of one foot from the ground, was five feet and eight inches in circumference, or nearly twenty-two inches in diameter. The trunk is covered with a very rough, scaly bark. The recent branches are of a yellowish green, somewhat downy, the older ones grayish. The leaves are on a very short footstalk, silky-downy above. They are very long and narrow, scythe-shaped, lanceolate, rounded or somewhat acute at base, tapering gradually to an extremely

[1] *N. A. Sylva*, III., 78.

long point, finely glandular-serrate, smooth and shining, and of the same color on both surfaces, which are, by the twisting of the petiole, presented almost equally to the light. The mid-rib is slightly prominent beneath, and somewhat silky above, and sometimes beneath. The venation is minutely reticulate, the secondary nerves scarcely distinguishable from the veins. Each leaf, before expanding, closely embraces those within it, and is, at that time, covered with a soft, silken down. The stipules are very conspicuous, semi-lunar or ear-shaped, auricled, pointed above, nearly embracing the new shoot, and glandular-serrate. The branches slender, extremely tough above. Aments expanding with the leaves, and borne on the end of a short, leafy branchlet, two inches long, and having, on its lower half, four or five short leaves. On the female ament, the scales are soon gone, exposing the brownish, downy, but not silky stem; the seed-vessels are nearly sessile, ovate acuminate, yellowish green, finally light brown, terminated by the two nearly sessile, black stigmas; ripe, in Worcester County, in the beginning of July, or before.

The effect of the mass of foliage of Pursh's willow, in the situations in which it is found, is striking and agreeable. The softness of the light reflected from it, without the changeableness, distinguishes it from the other willows; and the great length and slenderness of the stem give a peculiarly gentle motion to the whole mass when acted on by the wind.

Sp. 11. The Glossy Willow. *S. lùcida.* Muhlenberg.

The leaf is figured in the Annals of Botany, II., Plate 5, fig. 7, and in Michaux, Sylva, III., Plate 125.

Leaves ovate-oblong or lanceolate and narrow, with a long tapering point, smooth and shining on both sides, serrate; stipules oblong, toothed; stamens commonly five. — Overflowed banks of streams; rather common. — A beautiful species, sometimes flowering at the height of three feet, sometimes becoming a small bushy tree of twelve to fifteen feet.

A handsome small tree, sometimes twelve to fifteen feet high, and four inches diameter, usually smaller. The trunk is nearly smooth, and the bark externally much resembles that of a maple. The small branches are smooth, polished, and dark green. Recent shoots a shining yellow, those of the second year bronzed. The leaves have a singularly neat and definite outline, from one to two inches broad, by three and a half to five long. They are on short, compressed, smooth footstalks; ovate-lanceolate, or elliptic-lanceolate, rounded at base, tapering to a very long acuminate point; closely and sharply glandular-serrate, of a shining green above; lighter, polished and reticulate beneath. At the base of the leaf, on each side, are usually a few pedicellate glands. Stipules small, semicircular, glandular-serrate. Buds long, compressed, on the recent shoots bright yellow. The branches, large and small, are extremely brittle near the base; indeed, every part is brittle except the recent shoots, which are tough, but less so than those of most other willows.

This is the most beautiful of the willows. Hardly ever have I experienced more vividly the sense of beauty in inanimate nature, than on coming, unexpectedly, upon a low clump of this willow, in a little islet, on the edge of Meeting-House Pond, in Westminster.

GLOSSY WILLOW (Salix lucida.

WEEPING WILLOW. *Salix Babylonica.*

This willow is found in all parts of the State, and of New England. Sir W. J. Hooker says it is one of the most generally diffused of all the willows in British North America, being found throughout Canada, from Lake Huron to the Saskatchawan and Jasper's Lake in the Rocky Mountains, and to the Columbia River, and as far north as Fort Franklin on the Mackenzie River. It occurs as far south as Chester County, Pennsylvania.

Sp. 12. The Weeping Willow. *S. Babylónica.* L. *Introduced.*

The tree is figured in Loudon, VII., Plate 207; and in our Plates.

Leaves lanceolate, acuminate, finely serrated, glabrous, glaucous beneath; stipules minute, roundish; aments opening with the leaves; ovaries ovate, sessile, glabrous; branches pendulous. — *Pursh*, II., 614; *Willd.* IV., 671; *Loudon*, III., 1507.

A native of the banks of the Euphrates, near Babylon, of China, and of the north of Africa. It is supposed to have been introduced into Europe by the celebrated botanist, Tournefort, the great predecessor of Linnæus. Tournefort returned from his voyage to the Levant in 1702, at which time this willow must have been introduced. It is now extensively cultivated, as an ornamental tree, in those parts of Europe, as well as Asia, the north of Africa, and America, whose climate is favorable to its growth. It is almost everywhere considered a funereal tree, and has, in many places, taken the place of the cypress, in church-yards. To no other willow does the descriptive line of the poet of nature so well apply: —

> "And gracefully
> The willow, a perpetual mourner, drooped."

It is found in most parts of New England, although the climate is rather too cold for it, as is shown by the fact that the

branches often fail of ripening their wood, and are consequently killed by the succeeding winter.

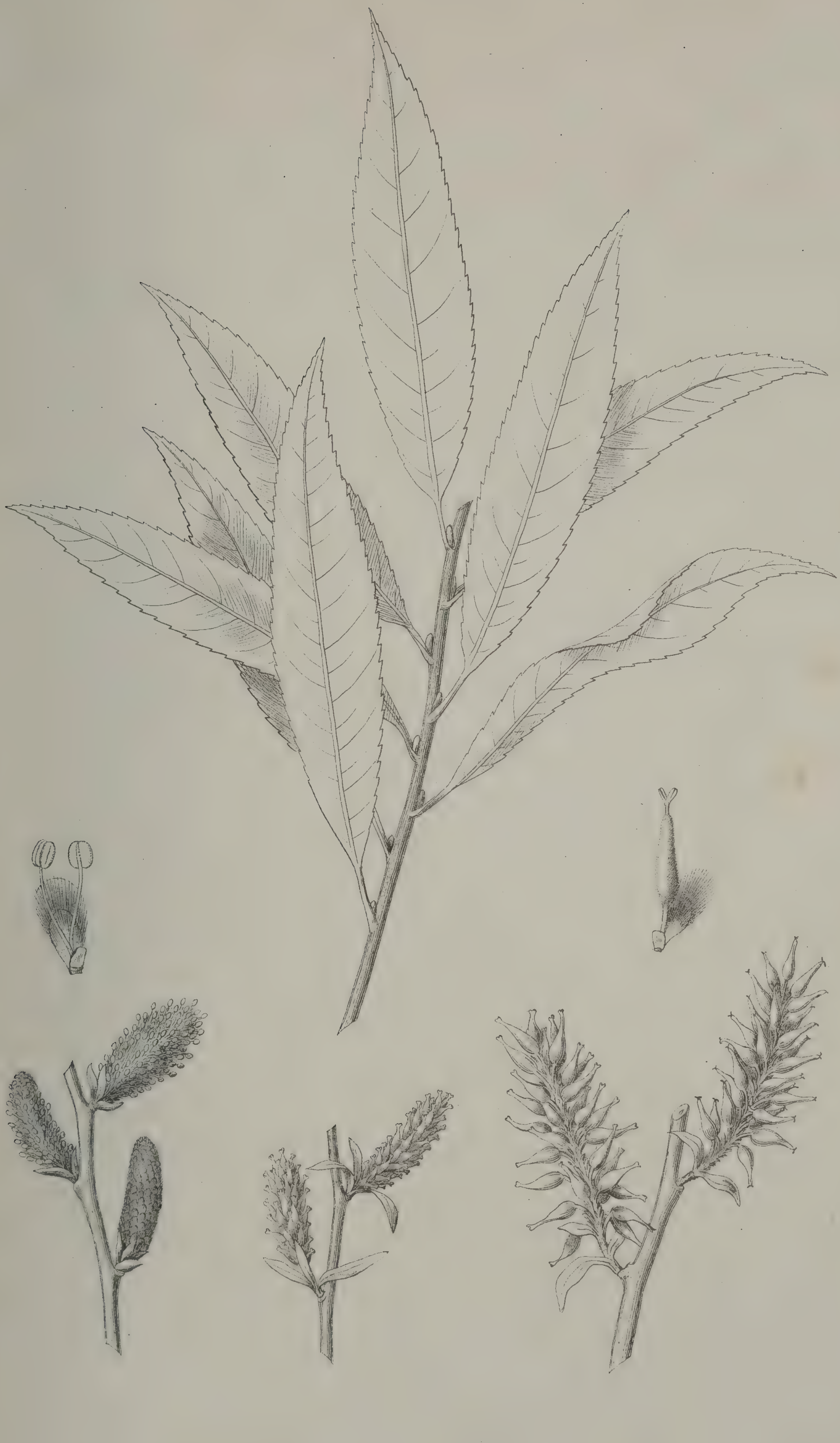
A singular variety of this willow called the *ring-leaved* willow, with curled or twisted leaves, is cultivated as a curiosity.

Sp. 5.* The Petioled Willow. *S. petiolaris.* Smith.

Leaves lanceolate, pointed, smooth above, slightly silky beneath, when young, at length smooth and glaucous; fertile catkins ovoid-cylindrical; scales acute, very hairy, scarcely as long as the stalk of the silky, tapering ovary; style distinct; stigma two cleft. (S. rosmarinifolia, and S. fuscata, *Pursh?*) — Same situations as S. sericea, which this resembles; but the mature leaves are not silky beneath nor so blackish in drying; the scales not so dark, and clothed with longer white hair; fertile catkins shorter and broader; the pods spreading and showing the stalks.

In the first edition, this species was not distinguished from *sericea*, which it closely resembles in habit and location; and a part of the description given applies to both species, but the specific characters, as given above, make them quite distinct. In the neighborhood of Boston, *petiolaris* appears to be the most abundant of the two.

WEEPING WILLOW ON THE THAMES, (As seen from Kew Garden.)



PETIOLED WILLOW. (*Salix petiolaris.*)

FAMILY IX. THE BREAD-FRUIT FAMILY. *ARTOCARPEÆ.* Brown.

This family consists, with a single exception, of trees and shrubs, with alternate, toothed, or lobed, or entire leaves, and milky juice. They are natives of tropical regions; two or three genera, *Mòrus*, *Broussonétia*, and *Maclùra*, being found towards the north, and a single species of *Mòrus*, as far as Canada.

To this family belongs the famous Upas tree, *Antiàris*, of Java, which has long been considered the most deadly poison in the world. And here, also, in strange companionship, are the Bread-fruit Tree, the Fig, the Mulberry, the Osage Orange, and the Fustic, a kind of mulberry which furnishes the well-known yellow dye. The juice of all is remarkable for being milky, and yet it is, even in those that produce wholesome fruit, usually acrid and of a suspicious character, and sometimes poisonous. Yet here also we find the Palo di Vacca, the famous Cow-tree of South America, which yields a large supply of rich and wholesome milk; and the fruit of several of the plants, besides those already mentioned, are eatable. The *Fìcus Religiòsa*, the Indian Fig, or Banyan tree of India, is justly looked upon as one of the signal favors of Providence to tropical India; furnishing to the traveller a natural temple, thick shade, and refreshing fruit.

This family is distinguished by having its fruit usually situated on or within a fleshy receptacle, covered by numerous nuts or drupes, — rarely a single one, — enveloped by a fleshy or pulpy involucre, and forming a compound fruit, like many berries or fleshy fruits grown together. The name *Artocárpeœ* was given by De Candolle to a section of the nettle family, to

indicate the most important tree of this group (the *Artocarpus*, literally bread-fruit), and the fleshy character of the fruit.

The only one native is, —

THE MULBERRY TREE. *MORUS.* L.

The flowers of the two sexes are usually on the same plant, sometimes on distinct plants. The male flowers are in a drooping, axillary spike, with a calyx of four-parted sepals and four stamens. Female flowers in ovate, dense, erect spikes; calyx of four sepals, concave, becoming pulpy and juicy. Ovary of two cells, one having one pendulous ovule, the other none. Stigmas two, long. When ripe, each ovary is a fleshy nut, covered by the fleshy calyx; the aggregate from a spike of flowers forming the compound *berry*.

The several species are trees, with white sap and alternate, rough, usually lobed, leaves, which are the favorite food of the silk-worm, the caterpillar of the *Bombyx Mòri*, but are hardly attacked by any other insect. There are ten or more species, two of which have been known from remote times.

The only species natural to New England, is —

The Red Mulberry. *M. Rùbra.* L.

Figured in Michaux, Sylva, III., Plate 116; and in Loudon's Arboretum, VII., Plate 183.

This species is found growing farther north than any other mulberry. Michaux thinks it is not found east of the Connecticut River, or north of Lake Champlain. According to Darlington, it sometimes reaches the height of thirty feet in Pennsylvania, and a diameter of from twelve to twenty inches, with numerous spreading branches at top. But Michaux found it, in the upper part of that State and in Virginia, sixty or seventy feet high, and sometimes two feet in diameter. According to all who have spoken of it, the wood is exceedingly

hard, strong, and durable. Michaux says it is almost as durable as the locust, and by many persons esteemed quite equal to it. In the southern ports, all that can be obtained of it is employed in ship-building, and it is preferred to every other wood except locust, for treenails. For posts, also, it is highly valued, from its durability when exposed to the weather. In boat-building, and for the light timber of vessels, it is preferred in Carolina to any wood except the red cedar.[1]

The use of its leaves as food for silk-worms has been tried, but not with encouraging success. The fruit is very agreeable, and by most persons is preferred to that of any other species.

I have found it growing wild on the Westfield River, where it is a small tree about twenty feet in height, like an apple tree. The recent shoots are gray, and somewhat downy. Larger branches, a light gray or brownish buff, smooth, with prominent gray dots. Trunk rough, with long superficial clefts and furrows. The leaves are heart-shaped, ovate or three-lobed, ending in a long point, rough on the upper surface, and downy on the lower.

The Black Mulberry, *M. nigra*, L., is occasionally cultivated here, as it has been in most parts of the civilized world from very ancient times, for ornament, and for its shade. It is supposed, from the circumstance of its being found, in great numbers, wild in the forests of Persia, to have been originally a native of that country, and to have been introduced thence, at a very remote period, into Europe; and others think it probable that it was brought, at a still more remote period, into Persia, from China. Its leaves are of no great value as food for the silk-worm, and its wood has not much strength or durability.

Several of the numerous varieties of the White Mulberry, *M. alba*, L., have been introduced, and are much cultivated in this country, with reference to the production of silk, the

[1] Elliott.

leaves having been long considered the natural and best food for the silk-worm. None of the varieties are so hardy as the black and red mulberries, — and their range of climate is much less extensive. Its native country is China; but it has been naturalized in several parts of Europe, and it flourishes in all the temperate parts of this continent. It is a rapidly-growing tree, reaching the height of twenty feet in five or six years, and, when fully grown, attaining that of thirty or forty feet.

The Many-stemmed Mulberry, *M. múlticaulis*, is a native of China, where it is said to be preferred for the food of silk-worms. Perrottet brought it from Manilla to Senegal in 1821, and, some years afterwards, to Europe. It has been extensively propagated in this country, and affords a great abundance of more delicate leaves than those of any other mulberry; and the silk formed by worms feeding on them, is considered very excellent, perhaps superior to any other.

The Paper Mulberry, *Broussonètia papyrífera*, so much resembles a mulberry tree in its general appearance that it has until recently been included in that genus. It is a low, thick-branched tree, with large, light colored, downy or hairy leaves, and dark scarlet fruit. It is very hardy, grows rapidly, has considerable beauty, and might be introduced as an ornamental tree, but is of no value for its wood. It receives its specific name from the fact that, in Japan and China, of which it is a native, its bark is manufactured into paper. In the South Sea Islands, where also it is found, the bark is made into the curious dresses which we sometimes see imported thence.

THE OSAGE ORANGE, *Maclùra auranti̇̀aca*, is a native of the banks of the Arkansas, and other regions west of the Mississippi. Its name was given by Nuttall in honor of William Maclure, a liberal and distinguished patron of the natural

sciences in North America. It is a beautiful, low, spreading, round-headed tree, with the port and splendor of an orange tree. Its oval, entire, pointed leaves, have the polished, shining green of natives of warmer regions; and its curiously tasselated, succulent, compound fruit, the size and golden color of an orange. It has been used to form hedges; to which use it is well adapted, as it is covered with stout thorns.

The male and female flowers, which are green and inconspicuous, are found on different trees; and different kinds must grow in immediate vicinity, in order that the fruit may be fertile. In the neighborhood of Philadelphia, I saw, in the Autumn of 1839, some fine specimens of this tree, several of which were loaded with fruit. I have rarely seen an object in the vegetable world more strikingly beautiful.

It was first introduced into St. Louis from the country of the Osage Indians, and thence received the name, which it well deserves, of Osage Orange. It has since been cultivated in many parts of this country and Europe, and has ripened fruit in several places in the south of France. It seems to be perfectly hardy in the latitude of Boston, as, at Nonantum Hill, in Newton, it has been found by Mr. Kenrick to have endured without injury the rigors of many winters.

The wood seems likely to be of great value. It is of a rich saffron yellow, whence it is sometimes called Yellow Wood, and resembles the *Maclùra tinctòria*, a tree of the West Indies, in yielding a yellow dye. It is of a fine close grain, and very elastic, and is preferred by the Indians to make their bows with, and thence called Bow Wood. It is hard and durable, and is said to receive a beautiful polish. It must therefore be valuable to cabinet-makers. It is said to rival even the live oak in durability as ship timber. From the bark, as from that of the Paper Mulberry, a fibrous substance resembling fine white flax may be formed. The use of its leaves as a substitute for those of the White Mulberry, for feeding silk-worms, seems to be of doubtful success.

It is easily propagated by layers, and by cuttings of the root. Loudon says that, in the vicinity of London, a plant cut down after having been two or three years established, throws up shoots six or eight feet high, and nearly half an inch in diameter, in a single season.

END OF VOL. I.